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The Practical Teacher

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BIOGRAPHICAL SKETCH OF SIR JOHN GORST, Q.C., M.P.,

Vice-President of the Committee of Council on Education.

THE Right Honourable Sir John Gorst, Q.C., M.P., was born in the year 1835, at Preston, Lancashire. He began his career of distinction at Cambridge, where he gained the honourable position of Third Wrangler in the Mathematical Tripos. A few years later he was elected a Fellow of St. John's College, a post which, fortunately, enabled him to develop to the full his natural inclinations and tastes. In those days Colonial sentiment was strong in a certain type of brilliant young Englishmen. The old country seemed to them cramped and tide-bound with convention, and they looked to the New World as to an El Dorado, not of gold, but of right living and purer human conduct. It was some such feeling as this which took Alfred Domett, the hero of Browning's 'Waring' to New Zealand; it was certainly this longing for a simpler, more natural life, which prompted a son of Arnold of Rugby to shake the dust of the Old World from off his feet and turn his face towards the virgin soil of the Australian Colonies, and it was doubtless with some such honourable enthusiasm that Mr. Gorst, as he then was, set sail for New Zealand in the year 1860. The affairs of that Colony were at that moment in a peculiarly interesting stage. 'I landed in New Zealand,' says Mr. Gorst in his book 'The Maori King,' written after his return to England, 'in May 1860, soon after the outbreak of the Taranaki War.' That is to say, he found himself, at the very outset of his colonial experience, face to face with that problem of the wise treatment of the native population which has confronted us in every portion of our Colonial Empire, and our solution of which has not always, unfortunately, been marked with success. From the first, Mr. Gorst seems to have shown the keen interest in the question, which might have been expected of him, and in 1861 the Colonial Government showed their sense of his ability and understanding of the subject, by appointing him Civil Commissioner and Magistrate at Waikato, at that time one of the most anxious and critical districts in the country. Here he spent two stirring and eventful years, the history of which he afterwards related in 'The Maori King,' to which we have already alluded. Anyone wishing to form an idea of our colonial methods of 30 years ago, cannot do better than read this undeservedly-forgotten book, every word of which is borne out by Mr. Rusdon's well-known 'History of New Zealand.' He will find in it a brightly-written narrative of events, always interesting and sometimes exciting, together with an able and impartial survey of our dealings with a brave and high-spirited race, and he will probably be surprised to see how full of good sense and intelligent sympathy was the attitude of this young man, fresh from an English University, upon an intricate question of practical politics. The fact, moreover, that at the present day the Maori population has actually begun to increase, shows that the view taken by Mr. Gorst was not merely the outcome of sentiment, but was the one which was destined ultimately to prevail. In 1863 he left New Zealand and returned to England, and the first chapter of an unusually active public life was closed.

But the taste for affairs once acquired is apt to go on growing. A man who has once known what it is to control the destinies of other men, who has felt all the exhilaration of direct contact and conflict with his fellows, does not afterwards easily content himself with the bloodless controversies of scholars, or the abstractions of mathematical science. The New Zealand experience practically decided Mr. Gorst's career, and henceforth the young Fellow of St. John's was to lead that life of constant political activity which seems to so many Englishmen the only life worth living. As many other young politicians have done before and since, he adopted the Bar as his profession. But his heart was in politics, and in the Election of 1866 he stood as Conservative candidate for the borough of Cambridge, and was elected. He does not, however, seem to have made any particular mark in the House during the two years which followed, and in the General Election of 1868 he was defeated.

For several years from this, though he devoted himself chiefly to his profession, he was by no means

politically idle. His gift for organization had become known to the leaders of the Conservative Party, which was then in a somewhat demoralized state, and a great deal of the work of re-organization was entrusted to him, and so successful was he in rallying the scattered forces of the Party, that many well-informed people regarded him, at the time, as largely responsible for the great Conservative victory of 1874. In 1875 he had the double satisfaction of being made a Q.C., and of returning to the House of Commons as member for Chatham, which constituency he continued to represent until 1892, when he was elected for the University of Cambridge.

During the five years from 1875 to 1880 the Tory Party, instead of profiting by the lesson they had learnt, allowed themselves again to fall into a state of incomplete organisation. Once installed in office with a large majority at their back, they soon began to show all the usual signs of over-security, and were even inclined to rebel against the enlightened policy which had brought them where they were. But Mr. Gorst and his friends saw clearly enough then, what the whole party has recognised since, that the Reform Bill of 1867 had rendered the old Tory methods worse than useless, and that for a Party to rely exclusively upon a privileged class, when the centre of political power had been shifted from that class to the mass of the people, was a proceeding, lacking, to say the least of it, in political foresight. And so, indeed, the event proved, for, as all the world knows, at the General Election of 1880 Mr. Gladstone was returned to power at the head of an overwhelming majority.

When the history of this century comes to be written, the five years from 1880 to 1885 will rank very high as regards both novelty and variety of political interest. Both of the Great Parties in the State were, so to speak, in the crucible, undergoing transformation, and both emerged from the process fundamentally changed and modified. The idea of Tory Democracy had, no doubt, originated in the fertile brain of Mr. Disraeli, but the men who did more than anyone or anything to bring the Tories into touch with the working-classes of the country were, undoubtedly, the men who formed that little oddly-assorted group, known throughout that Parliament, and to be known for ever afterwards in history, as 'the Fourth Party.' Regarded, at the best, as political hot-heads, at the worst, as 'malcontents,' no one was inclined to take very seriously the academic subtleties of Mr. Balfour, the impetuous but brilliant sallies of Lord Randolph Churchill, or the persistence of Mr. Gorst. At any rate, few even of the shrewdest political observers foresaw in the first of the three, the most powerful Chief Secretary Ireland has ever known; in the second a Minister who, if he had been gifted with more self-control, might have ousted Lord Salisbury from the leadership of the Conservative Party, and in the third, the future Controller of our educational destiny at one of its most critical moments. Yet, so it happened, and it is safe to say, that no political group so small, has ever won for its individual members such astonishing success.

On Lord Salisbury's accession to power in 1885, Mr. Gorst was appointed Solicitor-General, thus entering upon his official career. In the Conservative Administration of 1886 he was made Under-Secretary for India; and in 1890 he was admitted to the Privy Council. But another event in his career, of greater interest in the light of subsequent developments, took place in this same year. For some time past Mr. Gorst had been interesting himself in the labour question, then first beginning seriously to agitate men's minds and consciences, and in the summer of 1890 he was sent out as the British delegate to the Berlin Labour Conference. Of the part he took in it, and of his disappointment at the lack of support afforded to him by the Government on his return home, it is unnecessary to speak here. What is more important for us to note is that from this period dates Sir John Gorst's great, even passionate, interest in the vexed question of child labour, an interest of which he gave practical proof by his close attendance at the meetings of the Standing Committee on Trade, during the progress of Mr. Asquith's Factory Bill, and which rendered his selection by Lord Salisbury as Vice-President of the Committee of Council on Education, in the present Ministry, particularly appropriate. Of his general interest in the lives of the working-class he gave signal evidence some years ago by taking up his residence, for some months of the year, at Toynbee Hall, the well-known philanthropic settlement in Whitechapel. There, amid the constant discussion of economic and educational problems, and in daily contact with toiling men and women, Sir John Gorst has spent much of his time of late years, every hour of which has rendered him more capable of understanding the real needs of his age, and the peculiar problems which beset his present path.

Of his work at the Education Office it would, of course, be premature to speak. He follows a Minister who was before all things an educational expert, and who managed in a wonderfully short space of time to accomplish great and far-reaching results. At the same time we have every reason to believe that under Sir John Gorst the work of the Education Office will be carried on with the same open-mindedness, energy, and thoroughness which characterised it under Mr. Acland. That the new Minister, has, at any rate, no intention of being idle was made abundantly clear by his admirable speech delivered, at the Queen's Hall, on the 13th of November last. 'Marvellous progress has been made in education during the last 25 years,' he said on that occasion, 'but . . . there is plenty more for this generation to do. We have to secure that all the children throughout the country shall enjoy the education which the State provides. We have to raise the age of full and half-timers, and abolish the system of Standard exemption. . . . We have to stop the waste of mental gifts, none too plentiful, by completing the ladder by which the best intellects can mount from the most elementary to the secondary schools, and thence to the Universities. We have to make better provision for instruction in the art and science of teaching. We have to protect our child-teachers from excessive hours of intellectual labour, to form a registry of teachers, and to establish a national system of teachers' pensions. . . . We have to deliver the Poor Law children, and the reformatory and industrial-school children, from the workhouse taint of the one and the prison taint of the other, and so bring them up upon a system that will train more of them into honest men and women, and fewer into paupers and thieves.' Such

THE RIGHT HON. SIR JOHN ELDON GORST, M.P.

VICE-PRESIDENT of the COMMITTEE OF COUNCIL ON EDUCATION.

is the humane and enlightened programme which Sir John Gorst has set before himself and the country, and if he succeed in accomplishing even one-third of it he will have earned the gratitude of all classes in the community.

WELL-KNOWN TEACHERS AT WORK.

No. XLVI.—MR. LOOMBE C. BROOKE.

St. Marylebone Central Schools.

THERE is in London a large district in which, notwithstanding the rapid increase of Board Schools in other parts, the Voluntary Schools more than hold their own. We might, indeed, make the statement in a stronger form with a stricter limitation, and say that in this district Church of England Schools almost exclusively occupy the ground. If we take the parish church of St. Marylebone as a centre, we shall have to go a long distance—at least half a mile in any direction north, south, east, or west—before we meet with a school under the direct control of the School Board for London, although in most other parts of the metropolis such schools are clustered very closely together. Further, we might considerably extend our radius from the same centre without including more than three or four Board Schools, or even schools under any other than Church management. It might be interesting, and not very difficult, to account for the strong position which the Church maintains as regards elementary education in this district, but this would be rather apart from our present object, which is to introduce our readers to one of the best-known teachers in the district, and the work done under his supervision in one of the most successful of Voluntary Schools.

Yours truly
Loombe C. Brooke

The teacher is Mr. Loombe C. Brooke, and the school is St. Marylebone Central Higher Grade Technical School. The school buildings are conveniently and pleasantly situated in the close neighbourhood of the parish church. Indeed, they seem to occupy a part of the churchyard, for the north side of the boys' school looks out on the noble church across a sort of garden planted with lofty trees, while the south side is bordered by a strip of now disused burying-ground crowded with tombstones. The entrance to the school is from the High Street, where the head master has a dwelling-house and an office in which business connected with the school is transacted. Here, on the morning of our visit, we find Mr. Brooke busy over his time-table, consulting with the head mistress of the girls' department and one of the assistant masters with a view, as he explains to us, of providing facilities for the senior girls to share in the advanced instruction in science as given to the boys.

We meet with a very hearty welcome from Mr. Brooke, who displays the greatest readiness to show us whatever we wish to see in the work of his department. By way of introducing him to our readers, we venture to give a brief account of his earlier career as compiled from particulars he kindly supplied during our interview.

Mr. Loombe Cullum Brooke was born at King's Lynn, Norfolk, in 1847. In his native town he successfully completed an apprenticeship of five years as pupil-teacher at the St. Margaret's National School. He took a high place in the Scholarship Examination, being twenty-third on the list of Queen's Scholars, a result that secured for him a substantial recognition from his managers in the shape of a present of a five-pound note. It further secured for him, when he entered St. Peter's College, Peterborough, the distinction of being *dux* of his year; and this position, owing to his close attention to study, he was able to maintain throughout his course of training, for he took the first prize in each of his two years. As he was of a retiring and studious disposition, he gave close and unremitting attention to his studies; but he considers that the outcome of it all was, as regards general culture, somewhat disappointing. This result he attributes to the want of breadth which characterised the course of training provided in those days in the normal colleges, and more especially to the unpalatable and indigestible mass of memory work which occupied

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so much of the time which might have been better devoted to the mastering of more formative and liberal branches of study.

On leaving Peterborough at the end of 1869, Mr. Brooke was appointed to the Head Mastership of the Earl of Lindesey's School at Uffington, where he remained for 4½ years, and then became the Head Master of St. Matthew's School, Camden Town. Here he earned the very favourable opinion of H.M. Inspector, Mr. Alderson, and this becoming known to the managers of the Marylebone School, Mr. Brooke was visited by some representatives of the committee, and received an invitation to accept the Head Mastership of his present school, a post which he has continued to hold since 1878.

Let us now turn to the history of this educational institution, for that also has a record abounding in interest. It had its origin in one of the Charity Schools of the eighteenth century, which were established in connection with so many parish churches, and conducted in a quiet, unobtrusive manner under the control of the clergy. 'The design of these schools,' said Bishop Butler, preaching at one of the annual festivals of the charity children at St. Paul's Cathedral, 'was to give poor children the assistance which their circumstances plainly called for, by educating them in the principles of religion as well as of civil life, and likewise making some sort of provision for their maintenance—such as clothing them.'

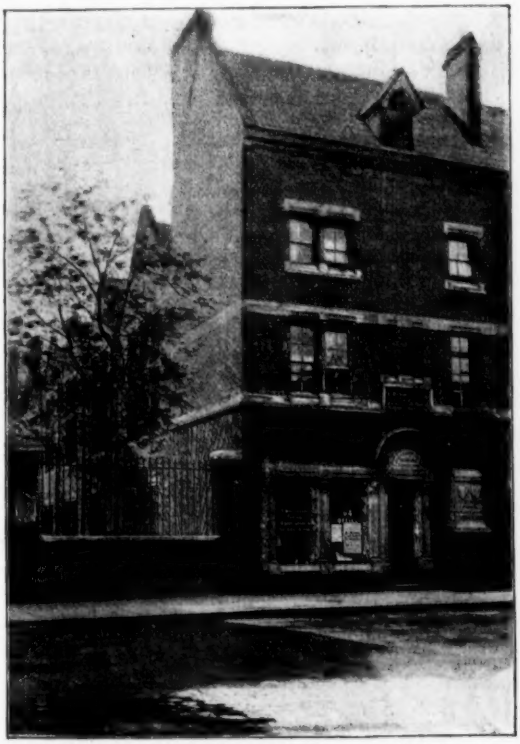
At first the children of the Marylebone School were taught the Church Catechism, reading, and writing, with a mere modicum of arithmetic. But changes gradually came over the character of the school. At the beginning of this century the monitorial system, favoured by Bell and Lancaster, was introduced. On the establishment of the National Society in 1811, the name 'National' was adopted for the school, and in 1855 Government help and supervision were accepted. Three years later new schools were built for 400 girls and 400 infants at a cost of £4,000, one-third of the amount being provided by Government. In 1863, by the munificence of Miss Bennett, a new school for 300 boys was erected in its present position, its walls bearing the inscription, 'To the Glory of God, and in memory of William Bennett, Esq., these schools were erected by his daughter, on freehold land given by the Duke of Portland, A.D. 1863.' The next—and, so far, the latest—important development took place in 1890, when, through the great liberality of two noble ladies—Lady Howard de Walden and the late Viscountess Ossington—and other generous friends, the boys' school was doubled in size, and the new portion was speedily adapted to the extension of the more practical parts of modern education. It includes a fine central hall about 80 feet long and wide in proportion, two large workshops for wood-work and metal-work, together occupying a space about equal to that of the hall, and a very extensive gymnasium nearly 20 feet longer than the hall. The buildings also include a chemical laboratory, a drawing school, and a number of separate class-rooms; and in the girls' department, with which we do not now propose to deal, a cookery centre is provided.

This brief account of the past history and development of the school should afford proof that we have here an institution with many features deserving attention, and may serve also, in some degree, to explain the somewhat ambitious name—the St. Marylebone Central Higher Grade Technical School. But, on the latter point, let us hear the head master.

'Yes,' he says, 'the title is somewhat ambitious and multiform, but it represents the complex character of its organisation. The word "Central" has special reference to the old National School erected by Miss Bennett, and marks the connection of this school with the mother church of the parish, as distinguished from the various churches of sub-parishes. The name "Higher Grade" refers more particularly to the school as reconstituted after the considerable enlargement of 1890, and marks also the fact that this is one of the comparatively few schools which were recognised under section 4 of the Education Act of 1890, and so were allowed to charge higher fees than ordinary elementary schools, as providing education suitable for the children in a neighbourhood inhabited by middle-class people. And, lastly, the world "Technical" refers to the Organised

Science School and to the Manual Training Department, the latter of which provides a very useful training for about 340 boys.'

It is to the last-named department that we first proceed in our survey of the school work, for it is on the ground-floor of the newer building, and is nearest at hand. On entering from the covered playground a remarkable sight meets our eyes, some dozen or fourteen boys are engaged in various kinds of metal work, under the supervision of an expert mechanical engineer, Mr. Arthur Wilson. Two forges, with anvils, are in full blast, and provide work for two boys each. Other pupils are engaged in working with chisels and files on pieces of steel held in clamps and vices. The shop contains also three turning lathes, including one specially adapted for screw-cutting, a drilling machine for boring holes up to $\frac{5}{8}$ inch diameter, a hydraulic press for testing the strength of pieces of work, a gas-engine, which is used to work the lathes, and a dynamo, by the aid of which it is anticipated that the electric light may be installed.



MARYLEBONE CENTRAL SCHOOL (entrance in High Street).

It is with much interest that we examine the specimens of work placed before us, some finished and others in progress. Amongst them are butt-joints of considerable size, nuts and bolts, brackets, letter-racks, and other ornamental articles in bent ironwork, and cut and hammered brass, and very substantial square-threaded steel screws. One of the large screws, some two inches in diameter, was cut, we are told, by a boy of 15 years of age, very recently taken into important engineering works. The bent iron work is also of a substantial sort, very different from that made with thin, almost wire-like, strips of iron, which can be bent with strong fingers. These specimens are practically wrought-iron work, needing the use of the forge, the vice, hammer, and pincers. An exercise on which some of the boys have recently been employed, is making an angle-gauge, a small plate of steel by which angles of 90°, 120°, and 135° can be tested. The teacher's drawing for this is on the blackboard, the boys' drawings are also at hand, and some of the finished specimens are on the bench.

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so much of the time which might have been better devoted to the mastering of more formative and liberal branches of study.

On leaving Peterborough at the end of 1869, Mr. Brooke was appointed to the Head Mastership of the Earl of Lindesey's School at Uffington, where he remained for 4½ years, and then became the Head Master of St. Matthew's School, Camden Town. Here he earned the very favourable opinion of H.M. Inspector, Mr. Alderson, and this becoming known to the managers of the Marylebone School, Mr. Brooke was visited by some representatives of the committee, and received an invitation to accept the Head Mastership of his present school, a post which he has continued to hold since 1878.

Let us now turn to the history of this educational institution, for that also has a record abounding in interest. It had its origin in one of the Charity Schools of the eighteenth century, which were established in connection with so many parish churches, and conducted in a quiet, unobtrusive manner under the control of the clergy. 'The design of these schools,' said Bishop Butler, preaching at one of the annual festivals of the charity children at St. Paul's Cathedral, 'was to give poor children the assistance which their circumstances plainly called for, by educating them in the principles of religion as well as of civil life, and likewise making some sort of provision for their maintenance—such as clothing them.'

At first the children of the Marylebone School were taught the Church Catechism, reading, and writing, with a mere modicum of arithmetic. But changes gradually came over the character of the school. At the beginning of this century the monitorial system, favoured by Bell and Lancaster, was introduced. On the establishment of the National Society in 1811, the name 'National' was adopted for the school, and in 1855 Government help and supervision were accepted. Three years later new schools were built for 400 girls and 400 infants at a cost of £4,000, one-third of the amount being provided by Government. In 1863, by the munificence of Miss Bennett, a new school for 300 boys was erected in its present position, its walls bearing the inscription, 'To the Glory of God, and in memory of William Bennett, Esq., these schools were erected by his daughter, on freehold land given by the Duke of Portland, A.D. 1863.' The next—and, so far, the latest—important development took place in 1890, when, through the great liberality of two noble ladies—Lady Howard de Walden and the late Viscountess Ossington—and other generous friends, the boys' school was doubled in size, and the new portion was speedily adapted to the extension of the more practical parts of modern education. It includes a fine central hall about 80 feet long and wide in proportion, two large workshops for wood-work and metal-work, together occupying a space about equal to that of the hall, and a very extensive gymnasium nearly 20 feet longer than the hall. The buildings also include a chemical laboratory, a drawing school, and a number of separate class-rooms; and in the girls' department, with which we do not now propose to deal, a cookery centre is provided.

This brief account of the past history and development of the school should afford proof that we have here an institution with many features deserving attention, and may serve also, in some degree, to explain the somewhat ambitious name—the St. Marylebone Central Higher Grade Technical School. But, on the latter point, let us hear the head master.

'Yes,' he says, 'the title is somewhat ambitious and multiform, but it represents the complex character of its organisation. The word "Central" has special reference to the old National School erected by Miss Bennett, and marks the connection of this school with the mother church of the parish, as distinguished from the various churches of sub-parishes. The name "Higher Grade" refers more particularly to the school as reconstituted after the considerable enlargement of 1890, and marks also the fact that this is one of the comparatively few schools which were recognised under section 4 of the Education Act of 1890, and so were allowed to charge higher fees than ordinary elementary schools, as providing education suitable for the children in a neighbourhood inhabited by middle-class people. And, lastly, the world "Technical" refers to the Organised

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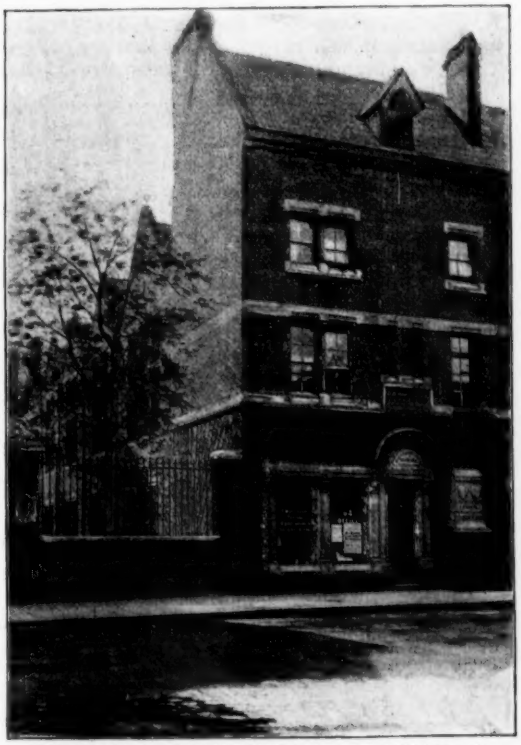

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'Do you make any other use of this educational provision beyond training the school boys you have mentioned?'

'Yes, on two evenings in each week, and on Saturdays, classes are held for adults, and many of those who attend the course are teachers, who feel that the training may be useful in connection with their own schools, or that it may form an agreeable sort of recreation.'

As there is much to see in this school we must now leave the manual training department, and the next place to which we are taken is the gymnasium, which occupies the basement of the last-built portion of the school, and is below the workshops. Here we find a company of half-a-dozen boys practising some rather difficult exercises on the parallel bars, under the guidance of a professional teacher of athletics. Mr. Brooke kindly offers to have some drafts of boys down later in the morning, that we may see the use made of this extremely commodious and well-equipped gymnasium. And as we gladly availed outself of this opportunity, we may as well relate at once what we found going on when we returned after visiting the schoolroom. The scene was a most animated one. Here, a teacher had a squad of boys going through a series of physical exercises; there, boys were practising on the parallel and horizontal bars. In one part, the vaulting-horse was in use; in another, the horizontal ladders; and in another, high jumping was practised. On a platform at one end, two boys were trying to pummel each other with boxing-gloves; and near them two others were engaged in fencing. It should be added that the latter exercises were under the immediate supervision of a teacher. The large room, about 100 feet long, is well lighted from one side, and well warmed by hot-water pipes. There are probably few schools with such excellent appliances for gymnastic training.

The out-door space is certainly of limited extent, but this is not unusual in London schools. The playground forms the ground floor of the older half of the school-building, which is built on arches. Good use is made of this small space, as we had opportunity of seeing. In it the boys are assembled and inspected before being marched upstairs to their class-rooms, and in it they form in lines, and sing grace before dismissal. They find it large enough, too, in the intervals for recreation and out of school hours, to have various games, even to practise football, for which game a team is off at about mid-day to some neighbouring ground on this very day of visit.

Now, we must go somewhat rapidly through the school proper. Everywhere we are struck by the practical and modern character of the instruction which is being given. In the large hall over the workshops, a science teacher is just finishing an experimental lecture on the chemistry of water, to which a large class of senior boys and girls have been listening. In the chemical laboratory, which is fitted up with benches for twelve students, we find one short of that number of boys engaged under another teacher, in collecting and purifying hydrogen gas.

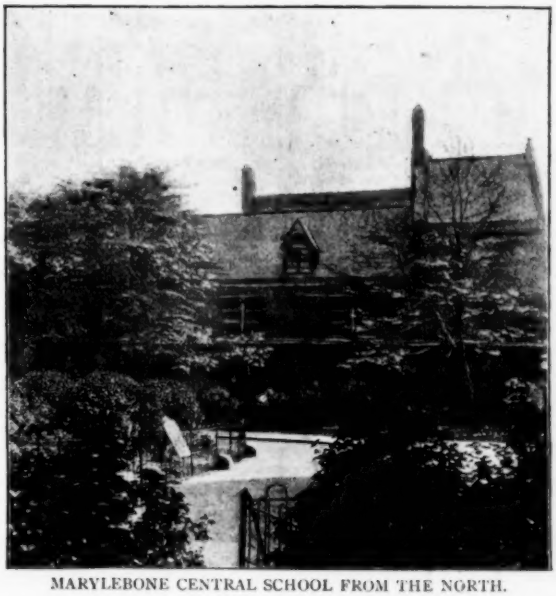
In one corner of the largest room, we find a typewriting machine in use, and our friend informs us that an expert attends for an hour a week to give the necessary instruction, to look over the exercises done by the pupils since his last visit, and to set others to be done before his next. Before we left, Mr. Brooke also showed us a neo-cyclostyle, which he has in his office for multiplying copies of typewritten circulars, examination papers, and so on.

One feature to which our attention was called struck us as quite a novelty in an ordinary school. This was a two-faced telegraph machine, at which two pupils could sit face to face and communicate with each other. The school has two of these machines, and Mr. Brooke considers them a very useful contrivance. He says, 'The pupils learn the Morse Alphabet, which may be of value to them in after life, since it is used, not only in the ordinary telegraph systems, but in the Army and Navy Signalling. The boys are taught to send and read messages; and as they have to write the questions and answers given and received, the machines form an interesting means of practising and testing spelling and composition. The writing of the communications acts as a check on wasting time and silly trifling, which might arise from abuse of the practice of telegraphic messages.'

We observe that the upright system of writing is in use, and Mr. Brooke says, 'Yes, some years ago we had in use a commercial style of moderate slope, for which we had some local fame. But when the school became so much larger, and the work had to be done in class-rooms under different responsible teachers, it became more difficult to maintain uniformity of style, and especially of slope, and I therefore adopted the upright system as more capable of being easily regulated with a large staff. Of course it has some other practical advantages.'

We are not surprised to learn that Shorthand and Book-keeping are among the subjects taught in this school. 'In recent examinations,' says Mr. Brooke, 'about 100 of our boys have gained the mark 'Excellent' for Pitman's Shorthand, and for Book-keeping.'

In a room known as the Music room, we notice in a frame a large tabulated list of boys of the choir. On inquiry we find that this relates to the choristers of the neighbouring parish church. Mr. Brooke offered to arrange for some singing, if time would allow during our visit; but, instead of this, as time was pressing, we undertook to attend the church and hear the music there. The choir is one of considerable size and of established fame. It includes about twenty-four men and sixty boys, ten of these being probationers. As the whole of the boys in the choir are pupils in the Central Schools, and the master is the secretary of the choir, a visit to the church seemed a very fair way of forming an opinion of the singing of the school. The departure from chronological order may be pardoned if we state that we have since attended the church twice. On the first occasion we heard a somewhat elaborate setting of the Canticles by Barnby, and an anthem taken from the *Messiah;* and on the second the greater portion of Gounod's cantata *Mors et Vita.* The ease and clearness with which the boys rendered Barnby's difficult music, their vigour of attack and fullness of tone in Handel's chorus, 'And the glory of the Lord,' and their sustained power in the rather trying and sombre strains of *Mors et Vita,* all combined to prove the excellence of their training, which is conducted, we understand, by the precentor of the church. Their becoming demeanour and admirable discipline in church must also be taken, we think, as reflecting credit on their school training.



MARYLEBONE CENTRAL SCHOOL FROM THE NORTH.

To return to the school. We ask Mr. Brooke if he will kindly give us any information and statistics bearing specially on organisation and methods adopted in the school. For answer he places in our hands a very full prospectus, copies of the time-tables in use, and a series of reward cards and certificates. From the prospectus we find that the staff includes, besides the Head Master, four other certificated Teachers, all holding additional certificates in Science and Art, and several special instructors for Science, Manual Training, Typewriting and Shorthand, Drill, Swimming, and the Violin. The Junior Boys are taught by two Assistant Mistresses, one of whom holds the L.L.A. Diploma. One paragraph of the prospectus runs thus: 'The managers feel convinced that a suitable combination of physical, manual, and mental training, with sound religious instruction, will conduce to the moral welfare of the boys, and implant in them a love of learning and a respect for manual and mechanical work. This course will, furthermore, afford ample scope for the discovery of the natural bent of a boy, and will enable the master to advise the parents on this point.'

The course of instruction shows, as we have seen during our tour through the rooms, that all the ordinary subjects of school work receive due attention; but we have limited our observations chiefly to those special features which distinguish this school from most other State-aided day schools.

'The Senior Class,' Mr. Brooke informs us, 'is intended for those who have passed the Government Standard VI., or who are able to pass an equivalent examination. It is conducted in a separate classroom, and is entirely distinct from the ordinary work of the school. Recognised as an organised science school, it is not under the rules of the Educational Code, but is examined by the Science and Art Department, and forms a Continuation or Secondary School in which pupils, both boys and girls, are enabled to prepare for various professions and occupations, and also for different examinations, especially those for the County Council Scholarships. The latest event in relation to this Department is its recognition by the Technical Education Board, as a school where the Junior Scholarships of the County Council are tenable, and two holders of such scholarships are now in attendance.'

The special time-table which is appended shows the subjects taught in the Senior Class. It provides, as will be seen, for instruction, not only in the subjects already mentioned, but in French and Physics, the latter being taught chiefly in lessons of a practical and experimental kind.

'And now will you give us some details of your scheme of reward cards and certificates?'

'I believe in giving credit and a word of praise wherever it is deserved, as an encouragement and incentive to conduct and progress. Hence the system of reward cards and certificates. At the end of each week, at the time appointed by the time-table, the teacher of each class gives to each of the scholars who has made perfect attendance during the week a white ticket, on the front of which is printed a statement of the reason for which it is presented. On the back the following summary of the scheme is printed: "A small Reward Book will be given in exchange for each of these tickets. A large Medal in Case will be given to boys who have made forty-four weeks' perfect attendance; a large Medal if only once absent or late; a small Medal if only

absent or late five times in the year. These boys will also receive a Reward Book, in addition to the Medals. Boys absent or late with leave not more than ten times will receive a Book Prize." Prizes and certificates are given also for good conduct, industry, and home work as determined by a system of marks awarded by the teacher.'

'You remarked that the school is one in which higher fees may be charged than in ordinary schools?'

'Yes; our scale of fees is, for Forms I. and II., 9d. per week or 6s. 8d. to 9s. per quarter; for Forms III. to V. 1s. per week or 9s. to 12s. per quarter; and for Form VI. and Seniors 1s. 3d. per week or 11s. 3d. to 15s. per quarter. The variation of the quarterly charge depends on the number of weeks in the quarter. Lessons on the pianoforte are given to some of the elder girls at a fee of 10s. per quarter. A class of elder pupils learn the violin and pay a quarterly fee of 6s. Swimming is taught by a master at the baths for 9s. per quarter. Bath tickets are supplied at 2d. each to scholars. Text-books and exercise-books have to be bought by the scholars.'

'And now as to results, Mr. Brooke?'

'Well, our school is well attended, and has an excellent reputation. Though the Government Inspector requires none the less in the ordinary routine subjects because we undertake work outside the code requirements, we get excellent reports. The highest grants have been invariably obtained also for our manual training department. Here is a tabulated return for one week in November, which shows the number on the roll in the boys' department to be 403, and the average attendance 367, the fees received £16 15s. 9d., and the percentage of attendance over 91. Of course the chief proof of a school's success is to be found in the character and position of the pupils in after life. And judged by that test, the school stands well. At all events we are able to give the boys a good start. In the last return of occupations made to the Education Department, we find that three boys started on the way to become dentists, one an engraver on brass, three engineers, one gold-refiner, one optician, three carpenters, three cashiers, amongst many of similar positions.

'To what causes chiefly would you attribute the remarkable success of your school?'

'In the first place, untiring attention has been devoted to the moral training and discipline of the boys. This has helped them to become good and capable citizens. Then I have endeavoured to conduct the school on sound business principles, and so to secure as far as possible its financial success. I have not been at all afraid of advertising what I believe to be a good thing, and what is advantageous commercially I consider is altogether likely to be educationally beneficial. Of course, it has been no easy task to maintain and augment the number of scholars in a school placed, as this is, in the midst of a West-end district, with streets close at hand like Harley Street, and many others from which practically no pupils can be drawn, as the houses are not peopled by those whose children attend elementary schools. Thus, it has needed all the business acumen and all the organising power I possess to keep the school and its work at a high level. Yet our numbers are now larger than ever, and I have to-day admitted the 3,030th boy since I first took charge of the school seventeen years ago.

'Another feature of our school is that its essentially voluntary character has been splendidly maintained. Large amounts, as I have stated, have been given from time to time for renewal and extension of the buildings. The last extension, provided by Lady Howard de Walden and Viscountess Ossington, cost £8,000; and, besides that, voluntary subscriptions to the amount of £3,000 have in recent years flowed into the school coffers. Of this the first of the ladies just named gave £500, Mr. William Debenham £100, and Mr. Seager £50. The Joint Committee of the City and Guilds of London Institute contribute now about £350 a year to our Manual Training Department.

'One more element in our success must be mentioned. This is undoubtedly the harmony of working on the part of all concerned in the school—Managers, Teachers, parents, and scholars. The motto of the school, inscribed on its walls, is, "Suffer little children to come unto Me, and forbid them not, for of such is the Kingdom of Heaven"; and the spirit of these words has always been the guiding principle of our Rectors, Managers, and Teachers. To the untiring energy and devoted activity of our present Rector, Canon Barker, we owe more than can be told. He takes, indeed, the liveliest interest in all things educational, and spares no personal pains and trouble in the supervision of these schools, the multifarious work in which could not be accomplished without his active sympathy and support, and the ample provision he supplies of the "sinews of war."'

This statement of the Head Master we can well believe. And it was with no slight pleasure that we had opportunity during our visit of renewing our acquaintance with the genial Canon, whose cheery face, kindly words of greeting, and hearty handshake really do one good.

MARYLEBONE CENTRAL SCHOOL.

TIME TABLE.

Standard.	8.45—9.	9—12.	9.30—9.45.	9.45—9.50.	9.50—10.30.	10.30—10.40.	10.40—10.50.	10.50—11.30.	11.30—12.	DAY.	1.50—2.	2.15.	2—4.30.	2—2.30.	2.30—3.	3—3.20.	3.20—3.30.	3.30—4.	4—4.30.
I.	Assembly—Cleanliness Marks—Registration—Prayers.		Spelling	Close Registers.	Arithmetic	Revision of Home Work.	Recreation.	Reading	Grammar	MONDAY.	Assembly—Cleanliness Marks—Registration—Grace.		Manual Work, 5, 6, and 7 — 25 Boys.	Drawing	Drawing	Mental Arith.	Recreation.	Geog. or Read.	Singing
II.					Arithmetic			Reading	Grammar					Drawing	Drawing	Mental Arith.		Geog. or Read.	Singing
III.					Arithmetic			Reading	Grammar					Drawing	Drawing	Mental Arith.		Geo. or French	Cpy. Bks. or Frch.
IV.					Arithmetic			Reading	Grammar					Drawing	Drawing	Mental Arith.		Geo. or French	Cpy. Bks. or Frch.
V.			Scripture		Arithmetic			Reading	Grammar					Drawing	Drawing	Poetry		Singing	Singing
VI.			Scripture		Arithmetic			Reading	Grammar					Drawing	Drawing	Poetry		Singing	Singing
VII.			Scripture		Arithmetic			Reading	Grammar					Drawing	Drawing	Poetry		Singing	Singing
I.			Spelling		Arithmetic			Transcription	Geography	TUESDAY.			Manual Work, 5, 6, and 7 — 22 Boys.	Reading	Arithme.ic	Word Building		Copy Books	Poetry
II.					Arithmetic			Dictation	Geography					Reading	Arithmetic	Word Building		Copy Books	Poetry
III.					Arithmetic			Dictation	Geography					Reading	Poetry	Word Building		Gram. or Sing.	Singing
IV.					Arithmetic			Dictation	Geography					Reading	Poetry	Word Building		Gram. or Sing.	Singing
V.			Shorthand		Arithmetic			Composition	Geography					Book-keeping	Book-keeping	Word Building		Grammar	Geog. or French
VI.			Shorthand		Arithmetic			Composition	Geography					Book-keeping	Book-keeping	Word Building		Grammar	Geog. or French
VII.			Shorthand		Arithmetic			Composition	Geography					Book-keeping	Book-keeping	Word Building		Grammar	Geog. or French
I.			Spelling		Arithmetic			Reading	Copy Books	WEDNESDAY.			Manual Work, 5, 6, and 7 — 35 Boys.	Drawing	Drawing	Geography		Reading	Singing
II.					Arithmetic			Reading	Copy Books					Drawing	Drawing	Geography		Reading	Singing
III.					Arithmetic			Reading	Copy Books					Drawing	Drawing	Mental Arith.		Geography	Reading
VI.			Scripture		Algebra			History	Copy Books					Drawing	Drawing	Mental Arith.		Geography	Shorthand
V.			Scripture		Algebra			History	Copy Books					Drawing	Drawing	Shorthand		Dictation	Singing
VI.			Scripture		Algebra			History	Copy Books					Drawing	Drawing	Shorthand		Dictation	Singing
VII.			Scripture		Algebra			History	Copy Books					Drawing	Drawing	Shorthand		Dictation	Singing
I.			Spelling		Arithmetic			Transcription	Geography	THURSDAY.			Manual Work, 5, 6, and 7 — 34 Boys.	Arith. (Tots)	Reading	Word Building		Copy Books	English
II.					Arithmetic			Dictation	Geography					Arith. (Tots)	Reading	Word Building		Copy Books	English
III.					Arithmetic			Dictation	Geography					Arith. (Tots)	Reading	Word Building		Gram. or Sing.	Singing
IV.					Arithmetic			Dictation	Geography					Arith. (Tots)	Reading	Word Building		Gram. or Sing.	Singing
V.			Shorthand		Arithmetic			Composition	Geography					M.Arith. or Tots	Book-keeping	Dictation		Geography	Gram. or French
VI.			Shorthand		Arithmetic			Composition	Geography					M.Arith. or Tots	Book-keeping	Dictation		Geography	Gram. or French
VII.			Shorthand		Arithmetic			Composition	Geography					M.Arith. or Tots	Book-keeping	Dictation		Geography	Gram. or French
I.			Spelling		Arithmetic			Reading	Grammar	FRIDAY.		2.15.	2—2.45.	2.45—3.30.		3.30—4.15.		4.15—4.30.	
II.					Arithmetic			Reading	Grammar				Word Building	Var. Occupins.		Drill			
III.					Arithmetic			Reading	Grammar				Drill	Maps		Object Lesson		Dismissal, Weekly Tickets and Libraries	
IV.					Arithmetic			Reading	Grammar				Drill	Maps		Object Lesson			
V.			Scripture		Arithmetic			Reading	Grammar				Maps	Drill		Object Lesson			
VI.			Scripture		Arithmetic			Reading	Grammar				Maps	Drill		Object Lesson			
VII.			Scripture		Arithmetic			Reading	Grammar				Maps	Drill		Object Lesson			

LOOMBE C. BROOKE, Head Master.

absent or late five times in the year. These boys will also receive a Reward Book, in addition to the Medals. Boys absent or late with leave not more than ten times will receive a Book Prize." Prizes and certificates are given also for good conduct, industry, and home work as determined by a system of marks awarded by the teacher.'

'You remarked that the school is one in which higher fees may be charged than in ordinary schools?'

'Yes; our scale of fees is, for Forms I. and II., 9d. per week or 6s. 8d. to 9s. per quarter; for Forms III. to V. 1s. per week or 9s. to 12s. per quarter; and for Form VI. and Seniors 1s. 3d. per week or 11s. 3d. to 15s. per quarter. The variation of the quarterly charge depends on the number of weeks in the quarter. Lessons on the pianoforte are given to some of the elder girls at a fee of 10s. per quarter. A class of elder pupils learn the violin and pay a quarterly fee of 6s. Swimming is taught by a master at the baths for 9s. per quarter. Bath tickets are supplied at 2d. each to scholars. Text-books and exercise-books have to be bought by the scholars.'

'And now as to results, Mr. Brooke?'

'Well, our school is well attended, and has an excellent reputation. Though the Government Inspector requires none the less in the ordinary routine subjects because we undertake work outside the code requirements, we get excellent reports. The highest grants have been invariably obtained also for our manual training department. Here is a tabulated return for one week in November, which shows the number on the roll in the boys' department to be 403, and the average attendance 367, the fees received £16 15s. 9d., and the percentage of attendance over 91. Of course the chief proof of a school's success is to be found in the character and position of the pupils in after life. And judged by that test, the school stands well. At all events we are able to give the boys a good start. In the last return of occupations made to the Education Department, we find that three boys started on the way to become dentists, one an engraver on brass, three engineers, one gold-refiner, one optician, three carpenters, three cashiers, amongst many of similar positions.

'To what causes chiefly would you attribute the remarkable success of your school?'

'In the first place, untiring attention has been devoted to the moral training and discipline of the boys. This has helped them to become good and capable citizens. Then I have endeavoured to conduct the school on sound business principles, and so to secure as far as possible its financial success. I have not been at all afraid of advertising what I believe to be a good thing, and what is advantageous commercially I consider is altogether likely to be educationally beneficial. Of course, it has been no easy task to maintain and augment the number of scholars in a school placed, as this is, in the midst of a West-end district, with streets close at hand like Harley Street, and many others from which practically no pupils can be drawn, as the houses are not peopled by those whose children attend elementary schools. Thus, it has needed all the business acumen and all the organising power I possess to keep the school and its work at a high level. Yet our numbers are now larger than ever, and I have to-day admitted the 3,030th boy since I first took charge of the school seventeen years ago.

'Another feature of our school is that its essentially voluntary character has been splendidly maintained. Large amounts, as I have stated, have been given from time to time for renewal and extension of the buildings. The last extension, provided by Lady Howard de Walden and Viscountess Ossington, cost £8,000; and, besides that, voluntary subscriptions to the amount of £3,000 have in recent years flowed into the school coffers. Of this the first of the ladies just named gave £500, Mr. William Debenham £100, and Mr. Seager £50. The Joint Committee of the City and Guilds of London Institute contribute now about £350 a year to our Manual Training Department.

'One more element in our success must be mentioned. This is undoubtedly the harmony of working on the part of all concerned in the school—Managers, Teachers, parents, and scholars. The motto of the school, inscribed on its walls, is, "Suffer little children to come unto Me, and forbid them not, for of such is the Kingdom of Heaven"; and the spirit of these words has always been the guiding principle of our Rectors, Managers, and Teachers. To the untiring energy and devoted activity of our present Rector, Canon Barker, we owe more than can be told. He takes, indeed, the liveliest interest in all things educational, and spares no personal pains and trouble in the supervision of these schools, the multifarious work in which could not be accomplished without his active sympathy and support, and the ample provision he supplies of the "sinews of war."'

This statement of the Head Master we can well believe. And it was with no slight pleasure that we had opportunity during our visit of renewing our acquaintance with the genial Canon, whose cheery face, kindly words of greeting, and hearty handshake really do one good.

MARYLEBONE CENTRAL SCHOOL.

TIME TABLE.

Standard.	8.50—9.	9—12.	9—9.30.	9.30—9.45.	9.45—9.50.	9.50—10.30.	10.30—10.40.	10.40—10.50.	10.50—11.30.	11.30—12.	DAY.	1.50—2.	2.30.	2—4.30.	2—2.30.	2.30—3.	3—3.20.	3.20—3.30.	3.30—4.	4—4.30.
I.	Assembly—Cleanliness Marks—Registration—Prayers.		Scripture	Spelling	Close Registers.	Arithmetic	Revision of Home Work.	Recreation.	Reading	Grammar	MONDAY.	Assembly—Cleanliness Marks—Registration—Grace.	Close Registers.	Manual Work, 5, 6, and 7 — 25 Boys.	Drawing	Drawing	Mental Arith.	Recreation.	Geog. or Read.	Singing
II.						Arithmetic			Reading	Grammar					Drawing	Drawing	Mental Arith.		Geog. or Read.	Singing
III.						Arithmetic			Reading	Grammar					Drawing	Drawing	Mental Arith.		Geo. or French	Cpy. Bks. or Frch.
IV.						Arithmetic			Reading	Grammar					Drawing	Drawing	Mental Arith.		Geo. or French	Cpy. Bks. or Frch.
V.			Scripture			Arithmetic			Reading	Grammar					Drawing	Drawing	Poetry		Singing	Singing
VI.			Scripture			Arithmetic			Reading	Grammar					Drawing	Drawing	Poetry		Singing	Singing
VII.			Scripture			Arithmetic			Reading	Grammar					Drawing	Drawing	Poetry		Singing	Singing
I.		Manual Work, 5, 6, and 7 — 14 Boys.	Scripture	Spelling		Arithmetic			Transcription	Geography	TUESDAY.			Manual Work, 5, 6, and 7 — 22 Boys.	Arithmetic	Reading	Word Building		Copy Books	Poetry
II.						Arithmetic			Dictation	Geography					Arithmetic	Reading	Word Building		Copy Books	Poetry
III.						Arithmetic			Dictation	Geography					Poetry	Reading	Word Building		Gram. or Sing.	Singing
IV.			Shorthand			Arithmetic			Dictation	Geography					Poetry	Reading	Word Building		Gram. or Sing.	Singing
V.			Shorthand			Arithmetic			Composition	Geography					Book-keeping	Book-keeping	Word Building		Grammar	Geog. or French
VI.			Shorthand			Arithmetic			Composition	Geography					Book-keeping	Book-keeping	Word Building		Grammar	Geog. or French
VII.			Shorthand			Arithmetic			Composition	Geography					Book-keeping	Book-keeping	Word Building		Grammar	Geog. or French
I.			Scripture	Spelling		Arithmetic			Reading	Copy Books	WEDNESDAY.			Manual Work, 5, 6, and 7 — 35 Boys.	Drawing	Drawing	Geography		Reading	Singing
II.						Arithmetic			Reading	Copy Books					Drawing	Drawing	Geography		Reading	Singing
III.						Arithmetic			Reading	Copy Books					Drawing	Drawing	Mental Arith.		Geography	Reading
IV.						Algebra			Reading	Copy Books					Drawing	Drawing	Mental Arith.		Geography	Shorthand
V.			Scripture			Algebra			History	Copy Books					Drawing	Drawing	Shorthand		Dictation	Singing
VI.			Scripture			Algebra			History	Copy Books					Drawing	Drawing	Shorthand		Dictation	Singing
VII.			Scripture			Algebra			History	Copy Books					Drawing	Drawing	Shorthand		Dictation	Singing
I.		Manual Work, 5, 6, and 7 — 12 Boys.	Scripture	Spelling		Arithmetic			Transcription	Geography	THURSDAY.			Manual Work, 5, 6, and 7 — 34 Boys.	Arith. (Tots)	Reading	Word Building		Copy Books	Copy Books
II.						Arithmetic			Dictation	Geography					Arith. (Tots)	Reading	Word Building		Copy Books	English
III.						Arithmetic			Dictation	Geography					Arith. (Tots)	Reading	Word Building		Gram. or Sing.	English
IV.			Shorthand			Arithmetic			Dictation	Geography					Arith. (Tots)	Reading	Word Building		Gram. or Sing.	Singing
V.			Shorthand			Arithmetic			Composition	Geography					M.Arith. or Tots	Book-keeping	Dictation		Geography	Singing
VI.			Shorthand			Arithmetic			Composition	Geography					M.Arith. or Tots	Book-keeping	Dictation		Geography	Gram. or French
VII.			Shorthand			Arithmetic			Composition	Geography					M.Arith. or Tots	Book-keeping	Dictation		Geography	Gram. or French
I.			Scripture	Spelling		Arithmetic			Reading	Grammar	FRIDAY.	2.15.	Close Registers.		2—2.45.	2.45—3.30.	3.30—4.15.		4.15—4.30.	
II.						Arithmetic			Reading	Grammar					Word Building	Var. Occupns.	Drill		Dismissal, Weekly Tickets and Libraries	
III.						Arithmetic			Reading	Grammar					Drill	Maps	Object Lesson			
IV.						Arithmetic			Reading	Grammar					Drill	Maps	Object Lesson			
V.			Scripture			Arithmetic			Reading	Grammar					Maps	Drill	Object Lesson			
VI.			Scripture			Arithmetic			Reading	Grammar					Maps	Drill	Object Lesson			
VII.			Scripture			Arithmetic			Reading	Grammar					Maps	Drill	Object Lesson			

LOOMBE C. BROOKE, Head Master.

MARYLEBONE CENTRAL SCHOOL.

TIME TABLE--SENIORS.

	MORNING.				AFTERNOON.			
DAYS.	9—9.50.	9.50—10.50.	10.50—11.	11—12.	2—3.	3—3.40.	3.40—3.45.	3.45—4.30.
Monday -	Mathematics (Arithmetic)	Mathematics (Euclid)	Interval	Chemistry (Theoretical)	Drawing	History	Interval	Physics
Tuesday -	Mathematics (Algebra)	Shorthand (Pitman's)	Interval	Physics	Book-keeping Section A. 2—3.30. Practical Chemistry	Geography	Interval	French
Wednesday -	Mathematics (Arithmetic)	French	Interval	Chemistry (Theoretical)	Geometry Section B. 3—4.30. Practical Chemistry	Grammar	Interval	Elocution
Thursday -	Mathematics (Algebra)	Shorthand	Interval	Physics	Book-keeping Section C. 3—4.30. Practical Chemistry	History	Interval	Grammar
Friday -	Mathematics (Euclid)	Mathematics (Arithmetic)	Interval	Physics	Geometry Sec. D. 10.50—12.20. Practical Chemistry	Geography	Interval	Literature, Grammar, or Composition

The Boys attend the Workshops one half-day a week in rotation.

LOOMBE C. BROOKE, Head Master.

'Of course, Mr. Brooke, as the master of such a school, you believe in the Voluntary system?'

'Well, although I am a Conservative in politics, I believe in a progressive policy as regards educational matters. But as to the question of Universal School Boards, with a purely secular programme for all the schools, I support the present system of compromise with the two kinds of school working side by side in their respective spheres. It may be admitted that, in theory and on paper, one uniform system sounds and looks the better; but such matters must be settled on practical considerations, and these seem to me to be very decidedly in favour of maintaining the present plan. Some further financial aid to Voluntary Schools would be a great boon, as in many cases a moderate addition to the income would make all the difference between a hard struggle for existence and comparative ease and comfort in securing efficiency.'

'And what is your attitude with regard to the National Union of Teachers?'

'In regard to that, I am also in favour of a progressive policy. I take a great interest in the work of the N.U.T., and rejoice in the increase in its numbers and influence. You know that this year I am President of the Marylebone Teachers' Association, and I took for the subject of my presidential address, the contrast between the position of Elementary Schools and their teachers in the earliest years of the Union and their position now. Twenty years ago pessimistic views prevailed, but now the outlook is decidedly promising. Improvement is visible all along the line, socially, politically, and educationally.'

'Yes, we had the pleasure of hearing that address, and thought it excellent in matter and well-timed.'

'Then, you know,' continues Mr. Brooke, 'that I am a loyal Unionist. I am glad to say that during my year of office our Association has increased in spite of some withdrawals to join a neighbouring Association, and that now we are stronger than ever. By-the-bye, you may be interested to know that Mr. Ernest Gray, M.P., ex-President of the Union, and now its Parliamentary Secretary, was taught as a pupil and trained as a Pupil Teacher in these schools. But that was just before my appointment here. It seems, however, to establish a sort of relation between this school and every member of the N. U. T. As to Union policy, I am in favour of District Unions. I am convinced that there exists a common ground for united action, on which Board and Non-Board Teachers can fight shoulder to shoulder in support of their common cause and interests. Voluntary Teachers must perforce fight for their own hand in many matters, just as Board Teachers are forced to do. But I believe their several interests are not necessarily inimical.'

This subject, however, is too large to be discussed here, and we must now take leave of our friend. We do, with hearty thanks for his courtesy and readiness to supply us with information, and with earnest wishes for the continued success of the important work he so ably superintends. We trust this account of Mr. Brooke's school may prove interesting to our readers. If it should unfortunately fail to do so, we fear we cannot plead that it is due to lack of interest in the material so amply provided to our hand. We are sure that every sincere supporter of all-round progress in popular education must wish that schools of the class of the Marylebone Central Schools, whether under the control of Boards or under Voluntary Managers, should be multiplied. Indeed, it is a great pity that differences of opinion and other obstacles have hindered the establishment of such schools in larger numbers, or that sufficient energy has not been devoted to surmounting the difficulties which stand in the way.

CLASS TEACHING AND MANAGEMENT.

BY J. GUNN, M.A., D.SC.

READING—(*continued*).

Some Common Faults in Reading.

1. **Reading word by word, instead of phrase by phrase,** is the most common fault in the early stages of reading. This seems unavoidable at the very earliest stage. But if all **new words** are studied thoroughly **before they are used in sentences,** and if **too many new words are not introduced** at a time, even in what we have called the primer stage this fault can be avoided.

Several methods may be adopted or invented to meet this case. One of the best is to ask the pupil to **tell** the teacher what he has just read. From the book he may have read, 'The—cat—is—on—the—mat;' but when asked to **tell** it, he looks up and says, 'The cat is on the mat,' quite naturally. The teacher may then ask what the sentence was about, and the pupil answers, 'The cat.' 'What is said about the cat?' 'It is on the mat.' The next step is to get him to **separate these two parts by a slight pause**—'The cat—is on the mat'—and then to read it so from the book. Other pupils then read the sentence with the same grouping of words, until the principle is familiar. By some such means as this the idea of grouping words becomes familiar and habitual.

2. **Bawling** or **shouting** is another common fault in young classes. It is usually worst when phrasing or grouping the words is not practised. The same plan may be taken to cure this fault. A boy who reads from his book at the full force of his voice should be asked in the same way to **tell** the teacher what he has just read. In most cases he will do so in a quite natural tone, perhaps in so low a tone that he may have to be asked to speak a little louder. When he has done so, he should then be asked to **read** the sentence **in the same natural tone.** At first he may fail to remember, and the contrast between the reading voice and the speaking voice is apt to strike the rest of the class as ludicrous; but a persistent use of this method will in most cases effectually abolish the tendency to shout.

It should be noticed that this fault may spring from various causes. Sometimes it arises from a **nervous eagerness** over the difficult task of reading, and more familiarity with the process will lessen the strain and lower the tone naturally; but, on the other hand, it is apt to become a permanent fault if not checked. Again, it is sometimes due to the **class being too large,** in which case the natural tone is felt to be too weak. But even in this case the pupils should not be allowed to speak louder than is absolutely necessary for audibility when there is, as there always should be, perfect order in the room. There is one reason for loud reading which has only to be mentioned in order to be condemned—the **want of perfect order** during the lesson. Loud reading is often an accompaniment of weak discipline, just as loud reading by the teacher often is. In this case the fault is the teacher's.

3. The opposite fault of **inaudible reading** is more common in older classes, especially girls' classes. This is more difficult to cure. It generally accompanies inaudible answering in oral examination. Simultaneous reading is sometimes resorted to, but not always with the desired effect. The pupils should be taught to believe that too low a tone is by no means a mark of good breeding, as some girls seem to suppose, but that it is really rude to speak so that a listener has to strain his ear to catch a reply. A peremptory order, or anything approaching to bullying a class in which this fault exists, has generally no effect, or an effect the reverse of what is intended. A general tone of healthy earnestness about the work is perhaps the only real cure, and this cannot be cultivated without time, care, and skill.

Simultaneous Reading.

Simultaneous reading is resorted to by many teachers as a kind of universal cure for faults in reading. It has a certain value in securing practice in phrasing, and in encouraging timid pupils. But in even a moderately large class the pupils for whose benefit the practice is adopted often take little or no share in the exercise. It can only be really effective when the class is so small that the teacher can watch the utterance of each child, as the leader of an orchestra can follow the tone of each instrument. And it is precisely in these small classes that simultaneous reading is found to be least necessary. It is an exercise which should be sparingly used, and only for some definite and specific purpose; and the teacher would do well to see whether that specific purpose is really being accomplished by it.

It should be remembered that the practice of simultaneous reading or recitation is apt to be hurtful to the musical ear of a class. The pupils read in all varieties of key, and the inflections are taken in all kinds of intervals. The result is painful to the listener, and dulls the sense of pitch in the performers. Many teachers of singing complain that it increases the difficulty of getting a class to sing in tune, as compared with other classes in the same school where the simultaneous exercise is less freely used.

Pattern Reading.

Many misleading half-truths have been written about reading being an imitative art, requiring much pattern reading by the teacher. It is the habit of some teachers to read the whole lesson first, sentence by sentence, followed by the pupils in the same way. Nothing could be more fatal to the development of the real power of reading. Reading is an imitative art in the same sense as speaking is; but the power of speech would be but indifferently developed if the child confined himself to phrases actually heard, without experimenting in the combination of words and phrases for himself.

Pattern reading should never extend to the whole lesson, or even any considerable part of it. The teacher should only use it for the purpose of **illustrating general principles** and **correcting faults of pronunciation and style,** which cannot be put right by the pupil's own attempts.

The abuse of pattern reading frequently reduces a class to such a pitch of helplessness that they will not attempt to pronounce a new word, however like one already known, **without first hearing it pronounced.** Even actual errors should be as far as possible corrected by a method designed to cultivate individual power, and with a view to avoiding similar errors in future. If a word is mispronounced, such a caution as, 'Put the accent on the last syllable,' or, 'Sound the **ch** hard,' or, 'The **g** is silent,' should be given; and

the children should be taught very early to know the meaning of such instructions. If the phrasing is faulty, get the pupil to look at the sentence and tell which words naturally go together according to meaning, or, at a later stage, according to grammatical relation, and then ask him to read it in accordance with the rules he has discovered and laid down for himself. Only in the last resort should the word be pronounced or the sentence read for him. Pattern reading should only be used as a pattern or type to be aimed at, not a means of avoiding the difficulties of teaching reading. If a fence has to be got over, show the boy where to climb it and if necessary stand by to help him if he falls, but don't lift him over. There are more fences in front, and the sooner he learns to climb the better.

The Qualities of Good Reading.

If word-building, and the habit of dealing with new words syllable by syllable in the light of words already known, are systematically practised, the difficulties of mere word-naming become fewer and fewer as the pupil advances. There are other points which meanwhile occupy more of the teacher's attention during the reading-lesson. But though their systematic treatment may come only in the later stages of the pupil's progress, the teacher should have had them distinctly before his mind from the very beginning. The following are the most important:—

1. **Pronunciation.** This term is generally restricted to the proper sounds of the **vowels** in a word. This point must be carefully attended to from the beginning.

2. **Enunciation** is usually understood to refer to the **consonant** sounds. The difficulties connected with this and the preceding point vary in different districts. Sometimes it may be the letter *t*, sometimes *ng*, sometimes *r* or *h* that is slurred over.

3. **Articulation** means the proper connection of syllables in a word, or of words in a phrase. The omission of unaccented syllables is the most common error under this head, and this omission is usually unnoticed by the speaker. It is due to the fact that the mouth is not opened to sound the short or unaccented vowel, and consequently there is no sound conveyed to the listener.

The **distinctness** of reading depends largely on articulation combined with the preceding qualities, and no amount of loudness will secure distinct utterance without proper pronunciation, enunciation, and articulation.

4. **Accent** is the stress laid on some individual **syllable** in a word. This is more easily secured. Pupils should be taught the meaning of the marks in common use both for accent and for long or short vowel-sounds, so that words thus marked in their books can be pronounced without the teacher's pattern.

5. **Emphasis** refers to the stress to be laid on particular **words** in a phrase, or on particular **phrases** in a sentence. It is thus an extended form of accent.

6. **Phrasing and voice-pauses.** The words which constitute a group or oratorical phrase are run together quite as much as the syllables in a word. These phrases or extended words must be separated from each other by a break in the continuity of the sound, which **does not necessarily mean a perceptible pause.** These voice-pauses are distinct from the pauses which are marked by punctuation; they are less formal, and often more difficult to learn.

These two qualities, emphasis and phrasing, are the most important elements in **intelligent reading** as compared with merely correct or distinct reading. They are necessary in order to show that the pupil **understands what he is reading;** and if he does not understand it, no rules will enable him to give the proper emphasis and phrasing. These qualities are also necessary to enable the listener to **understand what is being read.** In order to keep his ear attentive to these points, the teacher should avoid following the reading lesson on the book; the **reading should appeal to his ear,** not his eye. And the necessity for such qualities will be impressed on the class by the frequent practice of making the pupils read one by one to the class from some book or paper which is not in the hands of the others, and is not familiar to them.

7. **Fluency** or ease in reading is only possible when the difficulties of word-naming have largely disappeared. Fluency must not be confused with rapidity. It is rather to be developed by a deliberate style of reading, which enables the eye to travel in advance of the voice, and to grasp a complete phrase or clause instead of only one word at a time. **Rapid reading usually prevents fluency,** by the pupil in his hurry missing the true bearing of the various phrases, and by the actual slips and errors in words as well as in voice-pauses to which it leads. The only means of securing reading at once fluent and intelligent is to cultivate the habit of grasping the whole phrase before beginning to read it aloud, and for this deliberateness is at first essential, and always helpful.

Practice alone will produce ease and fluency, but this practice must not be in the form of re-reading familiar passages. It is rather practice in reading new matter which is wanted. The utmost glibness and apparent ease in reading the class-book may and often does accompany a remarkable want of fluency in reading new passages of a similar grade.

8. **Modulation and expression** may be taken together as describing the highest and rarest quality of good reading. This applies not merely to the inflection of the voice needed to show the completeness or incompleteness of a sentence, or to indicate a question. It also means that the tone of voice should be modulated to suit the kind of passage read. Expressive reading can be best cultivated by the reading of passages which make special demands on expression, such as conversation or dialogue, dramatic pieces, and good poetry.

There are other points which might be dealt with in detail, such as pitch, rate of speed, and the like, but they are either too obvious to need explanation, or have been incidentally taken up already. All the qualities enumerated above require careful notice in order to secure accurate, intelligent, and expressive reading.

The Teacher's Reading.

It is not every teacher of reading that can read well, and yet there is no subject in which example is so valuable an aid to precept. Many pupil-teachers get too little instruction and practice in the art, judging from the results produced. The young teacher must practise reading aloud for his own improvement, and should not be above making good use of his pronouncing dictionary. A distinguished teacher and professor of elocution says that he found nothing so helpful as the practice of reading aloud a few pages of such a dictionary now and again. Until we test ourselves in this way, probably few of us know how many words we habitually pronounce wrong, and how many unaccented syllables we never pronounce at all.

Another useful exercise for both teachers and pupils is that of reading aloud not merely a few lines, but a pretty long passage. Unless this is carefully

practised, the reading is apt to fall off in quality after the first sentence or two, or, from want of knowing or practising the proper way of breathing, the exercise is found very fatiguing.

General Reading.

The aim of our teaching should be **to cultivate the power of reading** rather than ability to read off one particular book. In young classes the **too frequent reading of the same book** leads to an unintelligent and deceptive fluency which is really reading by rote. The evil results of this are frequently seen in the form of blunders due to children saying the words which they expect to find, instead of those which actually are found in the lesson. This kind of inaccuracy seems epidemic in certain classes, and is always worst when the passage read is very familiar. Indeed, it is a matter of common experience that classes will read an unprepared passage more correctly and intelligently than the familiar lessons of their book. Intelligent reading implies that the pupil is taking an intelligent interest in what he reads, and it is difficult to do this with a passage in which every idea, and even every phrase and word, is familiar *ad nauseam*.

Hence the benefit of using two or three different books during the year, and, in classes old enough to make it practicable, of using other books, magazines, and newspapers for reading (and **listening**) practice. This use of general literature as a supplement to school-books is of great value likewise for the cultivation of intelligence, and for fostering a taste for reading. Extracts and articles should be most frequently chosen which have a special bearing on the geographical or historical studies of the class, or on some topic of interest at the time. These will often be helpful in giving a practical and interesting turn to studies which are apt to be rather abstract and dry to children. A school library which can be made use of for this purpose is of much service, and has this further advantage that books thus used in the class can afterwards be taken home and read in full by the pupils.

MODERN EDUCATIONAL REFORMERS.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),

Author of 'Mental Science and Logic for Teachers.' Late Director of the Birkbeck Training Classes and Lecturer therein on School Method.

No. XXIII.—JOHN CURWEN.

To the Greeks music was a necessary part of the instruction of the citizen. Plato, in his Republic, gives it the place of honour, expiating eloquently upon its humanising influence. Quintilian, whose 'Institutes of Oratory' is instinct with pedagogic wisdom, tells us that music is an excellent preparation for eloquence, and that it cultivates the sense of harmony, and a taste for number and measure. The Seven Liberal Arts of the Middle Age arranged in the trivium and quadrivium acknowledge music as one of the Sacred Seven. Rabelais, who is worthy of citation as one of the fathers of Realism, would have his Gargantua skilled in music. Luther, to whom should be ascribed much honour for sagacity in respect of education, especially when the gloom of his age is considered, laid down distinctly the same principle, saying, 'Unless a schoolmaster knows how to sing, I think him of no account,' seeing that 'music is a half discipline which makes men more indulgent and more mild.' Rousseau was equally clear as to his belief in music as an important item in education; for Emile, purposely shut off from all other studies, was to receive instruction in music and in drawing.

Shakspeare, in his insight and expressiveness, says 'the man that hath no music in himself, Nor is not mov'd with concord of sweet sounds, Is fit for treason, stratagems and spoils,' and an echo of the same sweet thought is contained in the beautiful oft-quoted couplet of Congreve—

> 'Music hath charms to soothe the savage breast,
> To soften rocks, or bend a knotted oak.'

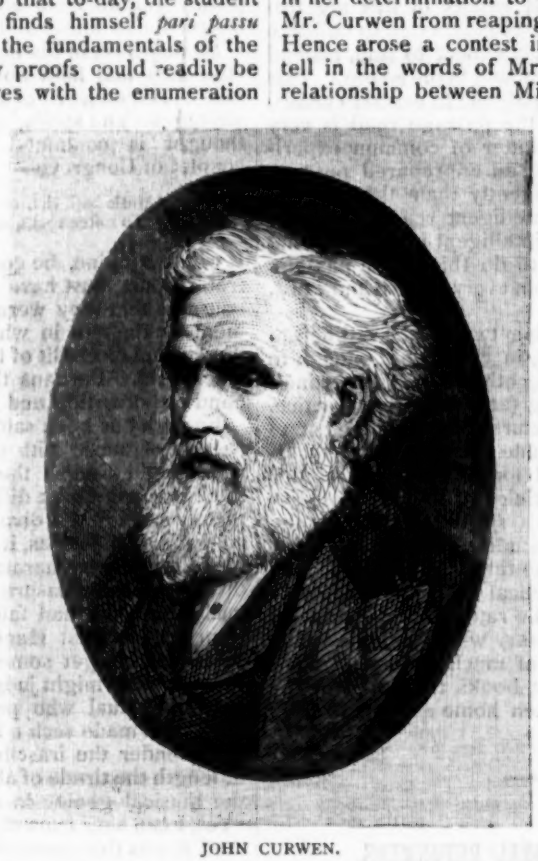
It will, we opine, be conceded on all hands that the troubadours must have it counted to them for righteousness that they were the prime agents of refinement for the age in which they lived, just as it is to the eternal discredit of the sterner and more fanatical amongst the Puritans that they put down with iron hand the diverting and elevating practice of music.

Enough has been said to point out the actual connection of music with education in bygone ages, as well as to establish the wisdom of the union. It is, therefore, somewhat difficult to understand how completely music was divorced from English education until recently, just as it is impossible to compute the loss to English character inseparable from such a divorce. The measure of the low degree to which musical culture had fallen in England, may be got from the fact that Handel, in a cathedral city, took some pains to get someone to sing a choral part, in order that he might judge of the effect thereof. The only individual who pretended to be able to sing from sight made such a frightful botch of the business as to render the irascible composer furious. When at length the tirade of abuse from Handel had ceased, the musical genius in question indignantly replied, 'Yes, I can sing from sight, but not from *first* sight!!' And it was this provoking inability to sing from first sight, or even from second or third sight, that set men searching for another and a simpler notation, which should make chorus singing simple and speedy. Amongst these searchers none were more assiduous, none more determined, than John Curwen, whose success once again led schoolmen back to the belief of Pythagoras and Plato and Quintilian, viz., that music is an inalienable factor in the education of mankind; nor is it likely that 'the concord of sweet sounds' will ever be subjected to the contumely of banishment again, by even the Vandals and the Goths amongst School Boards and School Managers. Such a drastic change was more than a reform: it was a revolution, running moreover on the soundest of sound educational lines; for, in addition to the names already mentioned in this connection, it is too well known to need mention, that both Pestalozzi and Froebel recognised in music a most powerful instrument of culture.

John Curwen was born in 1816, and died in 1880. He was educated at University College, London, being one of the earliest *alumni* of this now famous resort of studious Londoners. The training which he received at the hands of the professors of University College was a thoroughly good one, and, in addition to the lore of the teaching staff, he learnt their art to such an extent, that when he began his work as the apostle of music he was able to accomplish much in little time by virtue of his instinctive application of right methods. Nor has this happy possession of intelligent procedure ever deserted the pioneers of Tonic Sol-fa, so that to-day, the student of the Curwenian method finds himself *pari passu* engaged in the pursuit of the fundamentals of the teaching art. Of this many proofs could readily be given. We content ourselves with the enumeration of the principles of the Tonic Sol-fa method in illustration of this point :—

PRINCIPLES OF THE TONIC SOL-FA METHOD.

1. Let the easy come before the difficult.
2. Introduce the Real and Concrete, before the Ideal and Abstract.
3. Teach the Elemental before the Compound, and do one thing at a time.
4. Introduce, both for explanation and practice, the common before the uncommon.
5. Teach the thing before the sign, and when the thing is apprehended, attach to it a distinct sign.
6. Let each step, as far as possible, rise out of that which goes before, and lead up to that which comes after.
7. Call in the understanding to assist the skill at every step.



JOHN CURWEN.

Mr. Curwen, upon leaving college, entered the Congregational ministry, Basingstoke being his location, and, naturally, giving a lesson in singing twice a week to 200 children was one of his earliest occupations. There was teaching by ear and an attempt to give the power of singing at sight from the staff. His success was qualified, and being dissatisfied therewith, forthwith the task of self-improvement, coupled with an active search for a plan of campaign likely to lead to successful sight-singing, began. It was Mrs. Reed, the mother of the late Sir Charles Reed, London's best School Board Chairman, that drew Mr. Curwen's attention to the book by Miss Glover, of Norwich, on sight-singing, which finally led Mr. Curwen, in the fall of 1840, to the cathedral city of East Anglia. Here he found his *alter ego*, so far as aim was concerned, in the person of Miss Glover, who was also acting on the Platonic belief, that there is much salvation in music. Recognising the impossibility of getting children to appreciate similar intervals in different keys by teaching absolute pitch, this lady had insisted upon the necessity for learning the scale by sol-fa names, and this alone. This was a great advance upon previous practice, as Mr. Curwen readily saw, and, upon returning to London, he, in the same spirit as of old animated Archimedes under similar circumstances, exclaimed 'Eureka!' And 'found it' he had, in germ at least, and never was germ more untiringly and intelligently nursed and cultivated, until, at length, final fructification triumphantly asserted the sagacity of its cult.

The irreproachable integrity of Mr. Curwen impelled him to acknowledge, with eager appreciation, that his system was built up on the foundation prepared by Miss Glover, who, for her part, was resolute in her determination to do nothing likely to prevent Mr. Curwen from reaping the just fruits of his labours. Hence arose a contest in generosity, which we must tell in the words of Mr. J. Spencer Curwen: 'The relationship between Miss Glover and Mr. Curwen was always most cordial, and typical of the public spirit and self-renunciation of each. Mr. Curwen invested all his small savings in issuing his first book, which no publisher would take, and which several printers declined even to print. For 20 years, he tells us, he went on doing the same thing. His books and music yielded a small profit, and this he spent in bringing out more books, many of which he knew could not be remunerative, but were necessary to help his students. Then the tide turned; he began to receive more than he spent. But by this time a crowd of editors and publishers had begun to avail themselves of the permission which he freely gave to all persons to print music in Tonic Sol-fa notation, and Mr. Curwen found himself one among several competitors for the sale of Tonic Sol-fa books. The profits of his books, even to the end of his life, were never large. The proceeds of his first book, he tells us, he sent to Miss Glover, who returned them, with a friendly letter. After that he made repeated attempts, always unsuccessful, to get her to share in the results of the work which she had inspired. He managed to get a photograph of her taken, but his proposal for the painting of her portrait she steadily resisted. Miss Glover, naturally enough, did not consider Mr. Curwen's development of her plans an improvement on them, though she expressed her views on this subject in the most friendly way. Mr. Curwen tried twice to obtain her consent to the republication of her book, which had long been out of print, in order that the original upon which he had built might be before the public. Once he partially succeeded, but Miss G. changed her mind and withdrew her consent, after a few pages had been put in type. Two

months before her death in 1867, Mr. Curwen saw her at Hereford. "You not only do me justice," she said, "but you try to make me famous." In 1873 he renewed his attempt to get the book reprinted, but Miss G.'s surviving sister withheld her consent, saying, "May its offshoot long survive all competitors!" Mr. Curwen, before his death, had an oil-painting of Miss Glover produced, which now hangs at the Tonic Sol-fa College.' This amiable duel redounds vastly to the credit of the twin founders, and sheds quite a halo of romance round the movement for which they were responsible.

Meantime, in 1841, Mr. Curwen had been commissioned by a meeting of Sunday School Teachers, at Hull, to find a short and easy way to that sightsinging which all felt to be the *desideratum* if their work was to reap the full benefit that music could confer.

Accordingly, we find the minister now settled at Plaistow, an East London suburb, writing and studying in the early morning before proceeding to the performance of his ministerial functions.

In 1843 was published 'Singing for Schools and Congregations,' his first book. This was adopted by the Home and Colonial School Society, and there seemed a probability of the system coming into vogue. But the College was put under Government, and the Government scheme of singing had perforce to be adopted. This was Wilhelm's method modified by Hullah, who was the High Priest of the music cult from the standpoint of the Government. The reader need scarcely be reminded of the fact that Hullah adhered to the fixed Do, which, now that Mr. Curwen has introduced us to better things, is sufficient to account for its coming to naught. Toiling and moiling was the lot of the reformer, and success, to the man in the street, would have seemed just as far distant as at the onset. This was far from being the case, for surely was the system being spread abroad by the bands of earnest, if humble, Sol-faists who had been inspired by the master.

In 1851, at Jewin Crescent, was held the first gathering of the pupils of Tonic Sol-fa.

Six years later, 30,000 people—the largest musical audience ever before assembled—listened with rapt attention to the first children's concert at the Crystal Palace. In 1863 the Tonic Sol-fa College at Plaistow came into existence; and then began that system of examination which has developed to such an extent as to necessitate the issue to-day of between twenty-five and thirty thousand certificates per week.

In 1867, 'Perfidious Albion,' thanks to Mr. Proudman, was able to come out of the Paris Exhibition on an equality with the best French and Belgian choirs. Then came the recognition of the system by the Government, and the gradual ousting of Hullah's system, much to the chagrin of Hullah himself, who could never be brought to see the superiority of the rival system over that of Wilhelm, albeit that he adopted a modified movable Do towards the end of his career. That Tonic Sol-fa *is* vastly superior to all other modes of commencing sightsinging has been conceded by the most eminent musicians—such as Stainer, Barnby, and Bridge, no less than by the most accredited exponents of the science of acoustics—to wit, Lord Rayleigh and the recently-deceased Helmholtz, who speaks of it as the natural way of learning music. And now, from Greenland's icy mountains to Afric's sunny lands, from America, from China, and from all parts of the civilised world, testimony is forthcoming as to the widespread adherence to the principles and practices which have been elaborated into so fair a whole as is now exhibited by latter-day Tonic Sol-fa.

MISS GLOVER.

It is used by all religious denominations; it almost monopolises the schools; it appears cheek by jowl with the staff in most musical publications in that notation; its adherents are constantly gaining distinction in examinations where only the staff notation is recognised; in fact, it is to all intents and purposes all-prevailing and all-pervading.

If, as Herbert Spencer, backed up by all modern writers on pedagogics, teaches, *the complete life* is the aim of education—*i.e.*, we must ensure teaching on the physical, the mental, the moral, and the æsthetic sides of mind—how grateful should we be to the man who so persistently and so intelligently has worked out the musical making of the masses, and who, being dead, yet speaketh in the enterprising catering for the musical wants of our schools by the firm which bears his name and pursues his aims.

(We are indebted to Messrs. Curwen for the portraits of Miss Glover and Mr. Curwen, as also for their courteous readiness to supply us with information concerning the subject of the foregoing sketch.)

CONVERSATIONAL LESSONS IN CHEMISTRY.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),

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For particulars of the List of Chemicals and PRACTICAL TEACHER Set of Apparatus for working the experiments referred to in these lessons see numbers for January and February 1893.

LESSON XXIX.—SOAP.

IN our last lesson we dealt with fats and oils, and you learnt that these bodies are salts, *i.e.*, compounds formed by the union of a base with an acid. It was pointed out that the base is nothing more or less than the familiar substance glycerine, which is not an oxide or a hydrate of a *metal*, but the place of the metal is taken by a compound radicle which plays the part of a metal. I have gone over this ground again because it is somewhat difficult. Now, we proceed to make some soap, as being the best way to find out what its composition is.

Here is some caustic soda, with which you are by this time perfectly acquainted. What is its composition, Bob? It is sodium hydrate, sir. Yes, and therefore it is a *base*.

Here is some of the beef suet that I referred to last week, when you were told that its chief constituent—*stearin*—is a salt, the base of which is glycerine, and the acid stearic acid.

Now, put some of the fat into this beaker containing a small quantity of water, and proceed to boil for some time. Why do we boil, Lilla? Look, and you will see. Is it to make the fat mix with the water? Yes. The next thing for us to do, is to add about twice as much strong caustic soda solution as the water with which we started, and boil slowly for some time. Whilst the boiling is going on let us see what is taking place.

The bodies that we started with are—

$$\underset{\text{caustic soda}}{NaOH} + \underset{\text{glycerine stearate}}{C_3H_5(St)_3}$$

Each of these compounds is broken up by the heat thus—

$$Na \quad OH \quad C_3H_5 \quad St_3.$$

Re-combination takes place, but not in the same order as before. There is a rearrangement of particles resulting in the formation of sodium stearate NaSt and glycerine $C_3H_5(OH)_3$. The full equation representing this reaction you will see written up on the board thus—

$$\underset{\text{caustic soda}}{3NaOH} + \underset{\text{glycerine stearate}}{C_3H_5(St)_3} = C_3H_5(OH)_3 + \underset{\text{hard soap.}}{3NaSt.}$$

and yield glycerine and

This kind of reaction, which is at once both analysis and synthesis, is called *double decomposition*, and a very common reaction it is.

Now let us turn to our beaker. Where is the soap, Tom? I can't see it, sir. Quite so, and for a very simple reason. It is dissolved, and we must find some means of throwing it out of solution, or precipitating it, as it is termed.

Here is a solution of common salt. See, I add it to the solution of soap. What do you observe, Maud? The salt curds the solution, sir, and, I suppose, that the curds are the soap. You are quite correct in your surmise, and now please tell me what are required in order to make soap? Caustic soda and stearin, sir. Yes, but are there no more substances that can be used in place of these? Here in this bottle is another body closely resembling caustic soda. What is it, Trixie? It is caustic potash, sir. Yes, and lime water is a similar substance, so that we can have *sodium* soap which is *hard*, *potassium* salt which is *soft*, and *lime* soap which is *insoluble in water*. Well, Eva, what is your question? Can't we use other fats? Yes, of course we can, and do; we use, besides ordinary fat, palm oil, olive oil, and cocoa-nut oil. The last named is very useful, as it gives a very soluble soap which can be used in sea-water. Here is some distilled water, and here a solution of soap. Let Annie shake up a portion of the soap solution in the pure water. Notice that at once there is a lather formed.

Now, let Minnie do the same with ordinary water, and observe that there is no such formation of lather until after the addition of a much greater quantity of the soap solution. Why is that, Tom? The water is hard, sir. Yes, but what do you mean by *hard* water? It is water that contains substances in solution. Yes, and these substances will not permit the soap to form a lather, for the simple reason that they combine with it and so render it useless as soap. This is very important to the laundry people who do not want to waste their soap, so that means have been devised for softening water which is to be used for washing purposes. Boiling is one way. You remember that carbonate of lime can only be dissolved by water when the water has carbon dioxide in it. Now, when we boil our water the carbon dioxide goes off and the carbonate of lime is precipitated, and the water is greatly softened. Another way is to add lime, which again causes the precipitate and the dissolved carbonate of lime, and thus soap is saved.

But why do we use soap for washing purposes? I will show you.

Here is a bottle in which there is some olive oil. See, I add boiling water and still the oil remains, as hot water cannot dissolve fats and oils.

Now, let Harry pour in some of the soap solution, and, see, all the fat globules are broken up and dissolved, and the bottle is cleansed.

So long as we are alive a fatty substance is exuded from the pores of our skins which must be removed or we shall suffer. Soap performs this good office for us, and it does the like to our clothes.

Well, Minnie? If you please, sir, how are scented soaps made? If you reflect for a moment, my child, I think you will be able to answer your own question. The scent is added to the soap solution which is for toilet purposes, carefully freed from caustic alkali. One thing that I fully expected some of you to speak about seems to have quite escaped your notice. Go back to the equation, and then tell me what substance is formed conjointly with soap. Glycerine, sir. Yes, both in candle making and in the manufacture of soap large quantities of this very useful substance are produced.

Now, to what class of bodies do soaps belong? Take ordinary yellow soap as your example. Are they elements, mixtures, or compounds? They are compounds, sir. Yes, and I trust that a little consideration will enable you to tell me what class of compounds soaps belong to. Ah, I am glad to see that we have not missed this point. Let Trixie answer. Are they not salts, sir? Yes, ordinary yellow soap is the sodium salt of stearic acid, soft soap is the potassium salt, and so on.

Now let us sum up:—

1. Soap is a salt formed by the action of a caustic alkali on fats or oils by double decomposition. Glycerine is formed at the same time.
2. Common soap is sodium stearate.
3. Soap is soluble in water, but common salt precipitates it.
4. Hard water wastes soap, because the substances dissolved in the water combine with the soap and prevent it from lathering.
5. Water is softened (1) by boiling, (2) by adding lime, (3) by adding soap.
6. The usefulness of soap depends upon the fact that it is able to dissolve the fats which are exuded from our bodies and which soil our clothes.

NEW COMPOSITION STORIES.—STANDARD V. AND 1st YEAR P.T.'s.

Suitable for 'Unseen Tests' in Reading also.

464.

CAUGHT.—The Czar of Russia, when walking through a certain village, entered the house of the parish priest. Not finding him at home, the Czar, taking a seat, awaited his return. On glancing round the room he noticed a Bible well covered with dust, and placed on a shelf in the corner. The Czar opened it and inserted between the pages a number of banknotes; then, carefully closing the Book, returned it to its original position. Almost immediately the priest entered. 'How often do you read your Bible?' asked the Czar. 'Every day, sire,' was the reply. 'Every day, without missing?' 'Every day, your Majesty, without missing,' repeated the priest. 'I must compliment you,' rejoined the Czar; 'for I know of no better practice.' Two years passed, and the Czar again visited the village, and once more came to the house of the priest. Entering, he found the same Bible in the same place, and covered with dust as before. 'There is no doubt that you read your Bible very diligently,' said his Majesty, with biting sarcasm, as, opening the book, he found the large sum of money where he had placed it; and pocketing the same, he left the house without another word.

465.

THE SHAM DESERTER.—A man, joining the train to Edinburgh, found himself in the same compartment with a sergeant of soldiers and a deserter, of whom the former was in charge. The man engaged the sergeant in conversation, mentioned that he himself had been in the army, gave his company and name, and added jauntily, 'I am a deserter too.' The sergeant inquired, 'Is that so? Then you must come along with me,' and, suiting the action to the word, slipped the handcuffs on to his right wrist and linked him with the deserter. At this stage in the proceedings the new prisoner grew very indignant. After a while he explained that it was all a joke. But to all his representations the sergeant turned a deaf ear, and carried his new victim right through to Edinburgh. On arriving there he was taken to the castle, but it was not until ten o'clock at night that the process of identification was completed to the satisfaction of the authorities, and he was set at liberty.

466.

HOW THEY WERE DISCOVERED.—After the boys at a large boarding-school had gone to bed, two or three from one of the dormitories used to get up and have a game of leap-frog in their night-shirts in the corridor. This was discovered by a tutor, who told the lads not to do it again. Notwithstanding this, the game was repeated; but on the tutor rushing upstairs, he always found them all comfortably lying in bed, nor could he induce any boy to inform him who the culprits were. Determined not to be outdone, he went into the kitchen, and procured a small quantity of powdered blacklead, which he scattered about the corridor the next time that he left the dormitory. When next he rushed upstairs he raised the bed-clothes, and examined the feet of each boy, and soon had three offenders standing in front of him. In the dim light they had not noticed the blacklead, and the next morning they had to submit to punishment.

467.

EASILY SETTLED.—A story is told of a well-known musician, who, one day being in a music shop, accidentally broke a pane of glass. He expressed his sorrow; but the shopkeeper went into a violent rage, and loudly exclaimed that those who broke windows must pay for them. 'Certainly; but you might be civil,' said the musician. 'How much is it?' 'Five shillings.' 'Very well; there is half-a-sovereign.' 'I've got no change, and I've got no one to send out,' said the shopkeeper rudely. 'Perhaps you'll go and change it yourself?' 'Oh, we'll soon get over that difficulty,' returned the musician, irritated at the man's rudeness, and dashing his stick through another square: 'We are now quits. Good morning.'

468.

DIDN'T FORGET BUSINESS.—An old miller was once in a boat crossing the stream which drove his mill. The stream was flooded, and he was carried past the point at which he wanted to land, while further on misfortune overtook him to the extent that his boat was capsized. His wife, seeing the danger he was in, ran frantically along the side of the water, crying for help in a pitying voice, when, to her utter amazement, she was suddenly brought to a standstill by her better half yelling out: 'If I am drowned, Mary, remember that flour is up, twopence a stone.'

469.

THE FISH MOST IMPORTANT.—A Scotch nobleman invited an English friend to stay with him for some fishing. One day the Englishman, who was a novice at the sport, hooked a fine salmon, and in his excitement slipped and fell into the river. The keeper seeing he was no swimmer, hooked on to him with the gaff, and was about to drag him ashore, when his master called out: 'What are ye about, Donald? Get hold of the rod and look to the fish. My friend can wait a bit, but the fish won't!'

470.

CARRYING IT OUT TO THE LETTER.—At a small railway station a short time ago, the following amusing incident occurred. The station-master, while examining tickets, came across a cattle-dealer, well known in the district, who held a season-ticket. The station-master, aware of this, usually passed him without troubling him to show it. On this occasion, however, he ordered him to produce it, adding, in a severe tone, 'Mind, I want to see it every time you stop at this station.' The ticket was produced, examined, and the official passed on, looking very important and self-satisfied. A few days later, as the early morning mail train drew up at the platform at about 5 a.m., a passenger accosted the solitary porter on duty, and asked for the station-master. 'He is in bed, sir,' replied the porter. 'Tell him I want him,' said the passenger. The porter returned, after some delay, closely followed by the station-master, who was growling at being brought out of bed in the cold. On going to the carriage he was confronted by the cattle-dealer, who handed him his season-ticket, at the same time reminding him that he had a few days before expressed a wish to see it 'every time he stopped at the station.'

471.

RISKY!—On one of his trips in search of the pearl oyster a diver had a narrow escape from a fearful death. He had been instructed never to stir from the bottom until he had looked up and around. Fortunately, he heeded the advice. Having filled his bag, he glanced quickly about, and caught sight of a huge shark watching him. In an emergency men think fast. Near the diver was a large rock. He moved quickly to the other side of it, hoping to dodge the ferocious monster. But the manœuvre did not work; the shark watched every movement, changing his position by a slight motion of his powerful tail. Time was precious, and the diver conceived the idea of blinding the shark by stirring up the mud. Under cover of that he might escape. He worked for dear life, and had the water thick with mud in less than half a minute. Slipping round the rock again, he rose to the surface, having barely strength enough to reach the side of the boat, and was hauled on board just as the voracious man-eater made a rush for him.

472.

BETTER THAN PRECEPT.—The women of Cincinnati have lately performed a strange task with as much courage as humour. One fine morning about one hundred of them appeared in neat cotton dresses and sun hats, and armed with brooms and shovels, they forthwith began to sweep and clean the chief street of the town. The spectators, who soon assembled in crowds, cheered them heartily. At noon the women sat down on the doorsteps and consumed their dinners, which many had brought to them by their children. By sunset the chief roads of Cincinnati had, for the first time for six months, received a thorough cleaning. The women gained their point, for the local board were so much ashamed that they solemnly resolved henceforth to keep the place in that condition which is reckoned to be next to godliness.

473.

THE MILKMAN'S JOKE.—A certain milkman had occasion to visit a lunatic asylum to collect his weekly bill. Upon his departure he noticed one of the inmates abstractedly picking up some little stones. As the milkman passed the man he made some chaffing remark, and was at once pursued by the man. The milkman, now thoroughly frightened, ran for his life. Through the spacious grounds they raced, then out along the highway to the city. The pursued man yelled lustily for help; but none came, and at last, completely exhausted, he dropped on his knees to implore mercy. The lunatic rushed up, and, as he reached the crouching, trembling milkman, instead of crushing him, as he fully expected he would, he only raised his hand, laid it lightly on the man's shoulder, and cried out, 'You're hit!' and ran away. It turned out that the lunatic's one amusement was playing 'touch' with his keeper.

NEW READING TESTS.—STANDARD III.

Suitable for 'Unseen Tests' in Dictation also.

335.—Just as they rounded one of the corners of the square they noticed a crowd of children in the street close by, who, to judge from the peals of laughter which sounded almost every minute, were evidently enjoying themselves thoroughly with something in their midst, whatever it might be. 'I wonder whatever that is!' exclaimed Jack, as the two little ones stopped and watched them.—(H.M.I.'s Test.)

336.—She waited at the door and put her ear to the key-hole, listening; but there was no sound, so with a desperate courage she turned the handle and went in. It was very dark and she had to grope her way, but in the dusky light she could see Tom sitting in a great arm chair with a bandage round his head and his little face resting on his hand.—(H.M.I.'s Test.)

337.—Instead, however, of pushing the front of the canoe into the water and leaping into it as it was moving out (which would have been the action of an older person), she stepped timidly into the boat and carefully picked her way to the stern, where she raised the paddle that lay at her feet. 'Gracious! I didn't know it was so heavy,' she murmured, as she with difficulty lifted it.—(H.M.I.'s Test.)

338.—The same sheltering hand that had protected her thus far was not withdrawn, and she was held in her heavenly Father's loving care through the gloom and darkness of the night. No wild beast came near, and, though her body was chilled, she did not open her eyes until the sun was shining through the branches of the forest.—(H.M.I.'s Test.)

339.—And the profound stillness, the sense of hearing in the child was hardly less acute than that of the man. The soft murmur of the river was all that disturbed the quiet, until suddenly it was broken by the scream of a panther. He was on the other side of the stream, and so far off that he would have known nothing of the presence of the child.—(H.M.I.'s Test.)

340.—The day dragged on rather wearily. The recent fine weather had accustomed Willie to being a good deal out of doors, and he had got rather out of the way of amusing himself in the house. As soon as he had finished his dinner he set to work to prepare his lessons for the next morning, with a sort of hope that later in the afternoon his father might send for him.—(H.M.I.'s Test.)

341.—The warrior was so near the stream that he had but to turn to see the small round head of the panther swiftly approaching him. Guided by a singular fatality, the animal came directly toward the spot where the Indian was standing. He must have noticed the man and fixed upon him as his victim.—(H.M.I.'s Test.)

342.—When the heart with its grief is heavy,
And the eyes can no longer weep;
When we walk with footsteps weary,
Where the shadows gather deep:
There is One who sees all our sorrow,
Who teaches our heart to pray,
That the simple faith of the children
May be ours on our lifelong way.

NEW DICTATION TESTS.—STANDARD IV.

Suitable for 'Unseen Tests' in Reading also.

No. 360.

THE common cock-roach so familiar in our kitchens is not a native of this country, but was originally imported from Asia about two hundred years ago. It is, perhaps, needless to say that they were not purposely brought here, but came over as 'stow-aways' on board vessels trading with Eastern ports. For a long time they were only to be found in town houses, but notwithstanding their horror of cold journeys, they at length contrived to found colonies all over the country.

No. 361.

THE Government of Saxony has adopted a novel method to secure the payment of taxes. The names of persons who did not pay their taxes last year are printed and hung up in all the restaurants and public-houses. The proprietors dare not serve those mentioned on the lists with food or drink, under penalty of losing their licences.

No. 362.

ROOTS draw enormous quantities of moisture from the soil, and by this means it is discharged into the atmosphere. For example, the common sunflower has by experiments been found to exhale twelve ounces of water in twelve hours, and an oak tree, with an estimated number of 700,000 leaves, would in the same way give off something like 700 tons of water during the five months it carries its foliage.

No. 363.

THE French President travels free on the railways during his official tour in France, but when the return journey is concluded his secretary calculates what it would have cost if paid for at regular rates, and this sum is handed over to be distributed among the poorest paid of the railway men, and comes in helpful.

No. 364.

THE Chinese live in houses where the supply of air is so limited that no European could endure the vitiated atmosphere; yet they are a very healthy nation. This is due probably to the fact that their food is invariably simple and clean and thoroughly well cooked. Meat, potatoes, and rice are all boiled together. When cooked the mixture is put into small bowls, and as it is eaten with tiny chopsticks, it is impossible to try the mouth or stomach by scalding them with a quantity of very hot food. Moreover, they rarely drink water if they can get tea, either hot or cold.

No. 365.

THE hardy Norseman's house of yore
Was on the foaming wave,
And there he gather'd bright renown,
The bravest of the brave!
Oh! ne'er should we forget our sires,
Wherever we may be!
They bravely won a gallant name,
And ruled the stormy sea.
We still may sing their deeds of fame
In thrilling harmony;
For they did win a gallant name,
And ruled the stormy sea.

No. 366.

THE earliest chest was simply the trunk of an oak tree scooped out and cut down the middle, one half serving as a lid, which was at first kept closed by a strap of leather, and later by one made of iron. As late as the fourteenth century the oak chest, in addition to being a repository for valuables, served as a seat, and sometimes also as a table.

No. 367.

LIFE is a river, and man is the boat
That over its surface is destined to float!
And joy is a cargo so easily stored,
That he is a fool who takes sorrow on board.
We all have our taste of the ups and the downs
As fortune dispenses her smiles and her frowns;
But may we not hope, if she's frowning to-day,
That to-morrow she'll lend us the light of her ray.

No. 368.

SO fond are Russian women of smoking, that the CZAR has ordered the railway officials in the empire to provide passenger trains with smoking compartments for their use. It is said, on good authority, that nearly all married women in Russia smoke

cigarettes, and that the habit has begun to obtain largely among the unmarried, with the result that smoking carriages are now as much of a necessity for women as for men.

No. 369.

THE 'broad arrow' denotes that any article on which it is stamped or marked is the property of Government, and really means 'The King's Own.' Consequently, the marking or branding of a convict's uniform with the broad arrow denotes that he is the property of the Government, or, in other words, a prisoner. And should he be successful in making an escape, the very appearance of his clothing, stamped all over with the mark, informs the public that he is a convict.

No. 370.

IN Japan the postman wears a suit of blue cloth, a wide butter-bowl hat, and walks, or rather trots along in comfortable straw shoes. Sometimes a little two-wheeled cart bears his budget, or perchance, being light, the post-bag is carried by hand. From station to station the postman hurries along, often running mile after mile, to deliver his precious bag into the keeping of the next man on the route. In this way the mail is carried in the greater part of the Japanese Empire.

No. 371.

AT Quebec the winter markets are very curious. Everything is frozen. Large pigs, killed perhaps months before, may be seen standing frozen in the butcher's shop. Frozen masses of beef, mutton, deer, fowl, cod, haddock, and eels, long and stiff, like walking-sticks, abound on the stalls. Milk also is kept frozen, and is sold by the pound, in masses which look like lumps of white marble.

No. 372.

INDOOR air cannot be breathed all day long without serious injury, nor can a sufficient measure of physical exercise be dispensed with. Nature is stronger than all the doctors and drugs in the world, and she will not let a man be well who persistently disobeys her. She has made our limbs for movement and our lungs for pure air. If we do not use the limbs sufficiently, and breathe enough of perfectly pure air, she insists upon storing up quantities of poisonous waste in our system, and makes the arms and legs as limp as a jellyfish.

No. 373.

A WONDERFUL flower has been discovered in Central America. Its chief peculiarity is the habit of changing its colours during the day. In the morning it is white, at noon it is red, and at night it is blue. The red, white, and blue flower grows on a tree, and only at noon does it give out any perfume.

STANDARDS V.—VII., AND 1ST & 2ND YEAR P.T's.
Suitable for 'Unseen Tests' in Reading also.

No. 308.

ONE of the greatest pests in America at present is the common English sparrow. Our homely and comparatively harmless little friend seems to have developed the most rapacious instincts since his settlement in the New World, and is voted an unmitigated nuisance by American farmers. But the recent severe storms in America have almost exterminated the pest. The rainfall seems to have been so severe that it killed them by tens of thousands. Many persons think the sparrows were killed by being dashed by the wind against trees and buildings; but another explanation is that the fury of the storm caused them to drop from their perches from sheer exhaustion, and, unable to find shelter on the ground, they were drowned by the rain.

No. 309.

MEN do not accumulate money for its own sake; they purpose some use of it, some good that its possession is to bring to them welfare or happiness. Merely to amass money and to make no use of it is the most senseless of all things. It is to hunt the game, and not to roast it. How greatly and how variously men mistake the true use of property, and how often and signally they fail of the good that it might bring! There are men who seem really to think that in itself accumulation is a good, and long after enough for all probable or possible wants has been realised, they go on accumulating still, perhaps vaguely thinking that there is some advantage in the mere reputation of great wealth.

No. 310.

DURING the winter bees remain in the warmest part of the hive, and seldom venture out. They do not exactly hibernate, but they cluster very closely together. Their energies are concentrated upon the maintenance of heat, and all the activities of the hive are dormant. Yet, so early as the beginning of March, it begins to be known in the gloom and darkness of the hive that winter is well-nigh spent, and spring is at hand. Egg-laying, which is the sole duty and prerogative of the queen bee, is gradually resumed. The first egg laid sets in motion a whole round of duties. The queen has to be fed, and accompanied on her perambulations over the comb; the young have to be daily visited and attended; pollen has to be collected and stored for their food; wax has to be manufactured for the combs, and a considerable heat maintained for the general purposes of the hive.

No. 311.

ABOUT the most unnatural thing in Nature is the manner in which the young of the American wolf-spider treat their mother. After the little creature has laid her eggs, she carries them about in a ball, which she will defend with her life. When the young are hatched, they crowd on her back, and ride about until nearly half grown, when, realising their strength, they fall to and gobble up their mother. As a rule, the maternal relation is recognised in the animal and insect world only so long as need for protection exists; but this is about the only instance in which the young actually devour the parent by main force and by common consent.

No. 312.

THE crow is an alien. He shuns even the society of his kind. He and his mate—for, like many birds, crows are thought to pair for life—build their great nest high in the mighty elm no man can climb, in a sequestered corner of the valley, or perhaps in the heart of a gnarled and twisted thorn-tree, on the fringe of the moor. No bird will trust its homestead under the shadow of those sombre wings—unless, perchance, it be a stout-hearted misselthrush, who never hesitates to do battle for his own, and who shows a bold front even to the raven. The voice of the crow harmonizes with his character. A harsh and sullen croak it is, uttered now and then as he wings his solitary way homeward from some deed of mischief in poultry-yard or rabbit-warren.

No. 313.

BOOKS are like people. Certain of them, after the novelty of acquaintance with a new personality wears off, we have no desire to investigate further, sometimes because we are disagreeably impressed, oftentimes because we feel that there is nothing further to investigate. A few meetings, a hasty skimming, tell us all there is to tell. With others we have a pleasant companionship. It is true, they have lost some of their interest. We have weighed and measured them, and have nothing more to find out. They are not very deep, but an agreeable help to pass an idle half-hour. The books, like the people, are few in number of which we can speak as 'friends,' with which we have a ready sympathy; to which we turn with ever-increasing delight, as each meeting gives us fresh food for thought, each study shows us new beauties never before suspected.

No. 314.

IT is a remarkable and very instructive fact, that many of the most important operations of nature are carried on in unbroken silence. There is no rushing sound when the broad tide of sunlight breaks on a dark world and floods it with light, as one bright wave over another falls from the fountain, millions of miles away. There is no creaking of axles or groaning of cumbrous machinery as the solid earth wheels on its way, and every planet and system performs its revolutions. The great trees bring forth their boughs and shadow the earth beneath them; the plants cover themselves with buds, the buds burst into flowers, but the whole transaction is unheard. The change from snow and winter winds to blossoms and fruits and the sunshine of summer is seen in its slow development, but there is scarcely a sound to tell of the mighty transformation.

COMPOSITION TESTS.—STANDARDS VI. & VII., AND 1ST & 2ND YEAR P.T.'S.

Write at least 20 lines on ONE of the following:—

141. A description of a Fair or a Bank Holiday
142. The Houses of Parliament or the Tower of London.
143. Sunshine or Flowers.
144. 'Waste not, want not.'
145. 'Second thoughts are best.'
146. Some of the early signs of Spring.
147. Any Fairy Tale you can remember.
148. The British Army or Navy.
149. Friendship or Self Control.
150. The Sea and its Wonders.
151. A Winter Evening by the fireside.
152. A Railway Ticket or Smuggling.

MODEL ANSWERS TO QUESTIONS SET AT THE QUEEN'S SCHOLARSHIP EXAMINATION.

CHRISTMAS 1895.

ARITHMETIC.—MEN AND WOMEN.

Wednesday, December 18th, 10 to 12.30.

Candidates must answer THREE *only of the questions under Section* 1, *and may answer* TEN *other questions.*

If you answer more than THIRTEEN *questions, only the* THIRTEEN *answers coming first on your paper will be revised.*

More marks are assigned to the questions in Section 3 *than to those in Section* 2.

The solutions must be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered of no value.

SECTION I.

1. Explain the following terms :—Prime Factor, Decimal Fraction, Recurring Decimal, Simple Interest, Compound Interest, Ratio, Proportion.

A *Prime Factor* of a quantity is a factor which is not itself capable of being resolved into factors. Thus 3 is a prime factor of 36, but 6 is not a prime factor of the same quantity as $6 = 3 \times 2$.

A Decimal Fraction is one which has for its denominator 10 or some power of 10. Thus ·5, ·079 are decimal fractions as they respectively equal $\frac{5}{10}$, $\frac{79}{1000}$. The denominator in the first case is the first power of 10, and in the second case the third power of 10.

A Recurring Decimal is one which has one or more figures repeating themselves an infinite number of times. Thus ·3̇ and ·0714̇ are recurring decimals as they respectively equal ·3333, etc., and ·0714141414, etc.

A sum of money is said to be at Simple Interest when the interest each year is reckoned on the original principal.

A sum of money is said to be at Compound Interest when the interest each year is added to the principal for that year in order to make the principal on which the next year's interest is calculated.

The Ratio of two numbers to each other is the relationship existing between them with regard to their magnitude. In other words it is the quantity, fractional or integral, by which the second of the two quantities must be multiplied to produce the first. Thus 3 : 2 expresses the ratio which the number three bears to the number two. This ratio may also be expressed as $\frac{3}{2}$, since the second quantity 2 must be multiplied by this to produce the first quantity 3.

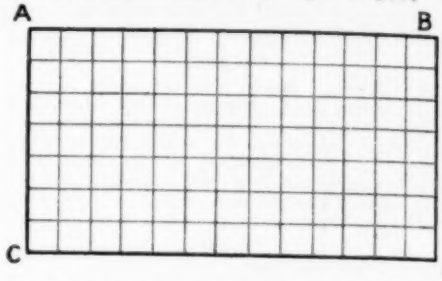
Proportion is the equality of two ratios. Thus the ratios 3 : 2 and 6 : 4 are equal, since in each case the second quantity (2 and 4 respectively) must be multiplied by $\frac{3}{2}$ to produce the first quantity (3 and 6 respectively). This proportion may be expressed symbolically thus :—3 : 2 :: 6 : 4.

2. Subtract 3948 from 6075, and explain each step clearly (as to a class) by the method of *Equal Additions*, or by that of *Complimentary Addition.*

$$\begin{array}{r} 6075 \\ 3948 \\ \hline 2127 \end{array}$$

Following the method of equal additions, since we take the unit figure 8 of the subtrahend from the unit figure 5 of the minuend, we add to the latter figure 10. $10 + 5 = 15$; $15 - 8 = 7$, which we place in the unit figure of the answer. Having added 10 to the minuend, we must add an equal quantity to the subtrahend. This we do by adding 1 to the tens figure 4. $1 + 4 = 5$, $7 - 5 = 2$, which we place in the tens figure of the answer. Since we cannot take 9, the hundreds figure of the subtrahend, from 0, the hundreds figure of the minuend, we add 10, that is ten hundreds, to the 0. 10 hundreds + 0 hundreds = 10 hundreds; 10 hundreds − 9 hundreds = 1 hundred. We therefore place 1 in the hundreds place of the answer. As we added 10, that is 10 hundreds, to the minuend, we must add an equal number to the subtrahend. We do this by adding 1, that is 1 thousand, which equals 10 hundreds, to 3, the thousands figure of the subtrahend. $1 + 3 = 4$; $6 - 4 = 2$. We place this 2 in the thousands place of the answer, which therefore = 2127. Since every time we added any number to the minuend we added an equal number to the subtrahend, our answer represents correctly what is left when 3948 is taken from 6075.

3. Show, by a diagram, that 7×13 is equal to 13×7.



The figure ABCD is a rectangle, which is $3\frac{1}{4}$ ins. long by $1\frac{3}{4}$ ins. broad. The length AB is divided into 13 equal parts, which therefore each equal $\frac{1}{4}$ in. The breadth AC is also divided into 7 equal parts, which each equal $\frac{1}{4}$ in. By drawing lines through the divisions of AB parallel to AC or BD, and through the divisions of AC parallel to AB or CD, the whole figure is divided into a number of equal squares, each having a base of $\frac{1}{4}$ in.

Looking at the horizontal rows of these equal squares we see that in each row there are 13 of them. There are seven rows in all, and therefore in the whole figure there are 13×7 such squares.

There are thirteen vertical rows of equal squares in the whole figure. In each row are seven squares. Therefore in the whole figure there are 7×13 equal squares.

But the whole figure was shown also to be made up of 13×7 equal squares. Therefore $13 \times 7 = 7 \times 13$.

4. Find the value, by Practice, of 59 yds. 1 ft. $7\frac{1}{2}$ ins. of silk at 5s. $10\frac{1}{2}$d. per yard, and explain the reason for each step of the work.

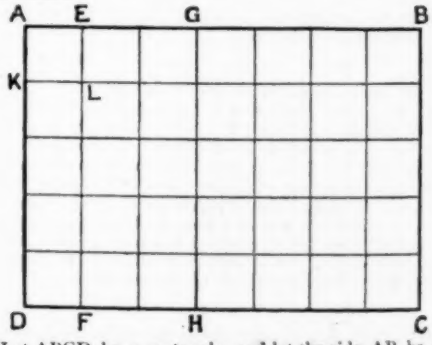
	s.	d.			
	5	$10\frac{1}{2}$	price of 1 yd. of silk.		
		59			
	17	6	$7\frac{1}{2}$	,, 59 yds.	,,
1 ft. = $\frac{1}{3}$ of 1 yd.		1	$11\frac{1}{2}$	,, 1 ft.	,,
6 in. = $\frac{1}{2}$ of 1 ft.			$11\frac{3}{4}$	,, 6 in.	,,
$1\frac{1}{2}$ in. = $\frac{1}{4}$ of 6 in.			$2\frac{15}{16}$	,, $1\frac{1}{2}$ in.	,,
	17	9	$9\frac{13}{16}$	,, 59 yds. 1 ft. $7\frac{1}{2}$ ins. of silk.	

We first multiply the price of one yard by 59, to get the price of 59 yds. Since 1 ft. equals $\frac{1}{3}$ of a yard, by dividing 5s. $10\frac{1}{2}$d. by 3, we get the price of 1 ft. This amounts to 1s. $11\frac{1}{2}$d. 6 in. equals $\frac{1}{2}$ of 1 ft. By dividing 1s. $11\frac{1}{2}$d., the price of 1 ft., by 2, we get the price of 6 ins. We have now only left $1\frac{1}{2}$ ins., which equal $\frac{1}{4}$ of 6 ins. We divide $11\frac{3}{4}$d., the price of 6 in., by 4, and thus get the price of $1\frac{1}{2}$ in. By adding the values of the separate parts of 59 yds. 1 ft. $7\frac{1}{2}$ ins. we get the value of the whole of the silk.

5. Define what is meant by the fraction $\frac{3}{7}$ and $\frac{15}{35}$, and show by a diagram that $\frac{3}{7} = \frac{15}{35}$.

The fraction $\frac{3}{7}$ means that a whole has been divided into seven equal parts, and that three of these parts have been taken to make the fraction.

The fraction $\frac{15}{35}$ means that a whole has been divided into 35 equal parts, and that 15 of these have been taken to make the fraction.



Let ABCD be a rectangle, and let the side AB be divided into seven equal parts, and the side AD into five equal parts. Through the divisions of AB draw lines parallel to AD or

BC. Then the figure is divided into seven equal rectangles like AEFD. Each of these is therefore $\frac{1}{7}$ of the whole figure, and since the figure AGHD is composed of three of these equal rectangles, it equals $\frac{3}{7}$ of the whole figure. Through each of the divisions of AD draw lines parallel to AB or CD. The effect of this is to divide the whole rectangle into a number of equal rectangles, each of the size of AKLE. Since each of the original seventh parts is composed of five of these smaller divisions, and since it takes 35 such figures as AKLE to make the whole rectangle, it follows that each division like AKLE is $\frac{1}{35}$ of the whole figure, and that $\frac{1}{7} = \frac{5}{35}$. And since the figure AGHD, which was shown to be equal to $\frac{3}{7}$ of the whole figure, consists of three columns of small figures like AKLE, and that each column contains five of the small figures referred to, and that each of them equals $\frac{1}{35}$, it follows that

$$\frac{3}{7} = \frac{5 \times 3}{35} = \frac{15}{35}.$$

6. If a system of decimal coinage, weights, and measures is at some future time established in Great Britain, what modifications must be made in the arithmetic taught in schools? For instance, what method would then be used to solve questions which are now worked by Practice?

If a system of decimal coinage, weights, and measures were introduced into Great Britain the varying multiples in the weights, measures, and pence tables would be abolished, and in their place we should have ten, or some power of ten. Consequently, the various fractions of a unit of a weight, measure, or coin could be expressed decimally, and we should employ decimals more extensively in arithmetic working. It would, therefore, be necessary to introduce the teaching of decimal fractions much earlier in the school course than is now done. The teaching of the tables would be very much simplified. The child would learn the prefixes which signify multiples, and those which signify fractions of the units of the various weights and measures, and then he would simply have to learn the names of these units in order to render his knowledge of the tables complete. Further, as every successive step in the tables goes by ten, the risk which now exists of a child multiplying or dividing by the wrong number would be abolished. The troublesome fractions ($5\frac{1}{2}$, $30\frac{1}{4}$, &c.) now existing in the tables would also disappear. Questions which are now solved by Practice would become exercises in Multiplication of Decimals.

Section II.

7. Find (*a*) the G.C.M. and L.C.M. of 84, 105, and 77, and (*b*) also the value of $\frac{1}{84} - \frac{1}{105} + \frac{1}{77}$.

(*a*)
$$\begin{array}{r|l} 7 & 84,\ 105,\ 77 \\ 3 & 12,\ 15,\ 11 \\ & 4,\ 5,\ 11. \end{array}$$

L.C.M. $= 4 \times 5 \times 11 \times 3 \times 7$
$= 4620.$

The above working also shows that 7 is the only number which will divide 84, 105, 77, an exact number of times. Therefore, their G.C.M. = 7.

(*b*)
$$\frac{1}{84} - \frac{1}{105} + \frac{1}{77}$$
$$= \frac{55 - 44 + 60}{4620}$$
$$= \frac{71}{4620}.$$

8. Divide 150 guineas to the nearest penny among 19 persons. What must be added to the 150 guineas to make each person's share £9 6s. 10d.?

150 guineas = £157 10s.

£157 10s. ÷ 19 = £8 5s. 9d. + 9 pennies.

$$\begin{array}{r|l} & £\ \ s.\ \ £\ \ s.\ \ d. \\ 19 & 157\ 10\ (8\ \ 5\ \ 9 \\ & 152 \\ & \hline & 5 \\ & 20 \\ & \hline & s. \\ 19 & 110\ (5 \\ & 95 \\ & \hline & 15 \\ & 12 \\ & \hline & d. \\ 19 & 180\ (9 \\ & 171 \\ & \hline & 9. \end{array}$$

Amount which must be added to 150 guineas to make each person's share £9 6s. 10d.
= (£9 6s. 10d. × 19) − £157 10s.
= £177 9s. 10d. − £157 10s.
= £19 19s. 10d.

9. If the earth made a complete revolution every 24 hours, through what angle would it turn in 5 hours 30 minutes 30 seconds?

24 hours = 86,400 sec.
5 hrs. 30 min. 30 sec. = 19,830 sec.
Angle completed in 86,400 sec. = 360°
,, ,, 1 sec. = $\frac{360}{86400}$°
,, ,, 19,830 sec. = $\frac{1}{360} \times \frac{19830}{86400}$°

$$= \frac{661}{8}° = 82\frac{5}{8}°$$
$$= 82° 37' 30''.$$

10. How many times is the difference between

$\frac{3}{4}$ of $\frac{2}{3}$ and $\frac{2}{5}$ of $\frac{5}{8}$
$\frac{1}{2}$ $\frac{2}{3}$ of $4\frac{1}{2}$

contained in their sum?

$$\frac{\frac{3}{4} \text{ of } \frac{2}{3}}{\frac{1}{2}} = \frac{2}{3} \times \frac{3}{4} \times \frac{2}{1} = 1.$$
$$\frac{\frac{2}{5} \text{ of } \frac{5}{8}}{\frac{2}{3} \text{ of } 4\frac{1}{2}} = \frac{2}{5} \times \frac{5}{8} \times \frac{9}{2} \times \frac{2}{9} = \frac{1}{4}.$$

Difference $= 1 - \frac{1}{4} = \frac{3}{4}$.
Sum $= 1 + \frac{1}{4} = \frac{5}{4}$.
No. of times difference is contained in sum
$= \frac{5}{4} \div \frac{3}{4} = \frac{5}{4} \times \frac{4}{3} = 1\frac{2}{3}$.

11. Express 2·03125 miles − 7·3215 furlongs in feet.

1 mile = 5,280 ft.
1 furlong = 660 ft.
2·03125 miles = (2·03125 × 5,280) ft.
= 10,725 ft.
7·3215 fur. = (7·3215 × 660) ft.
= 4832·19 ft.
10725 ft. − 4832·19 ft. = 5892·81 ft.

12. How many metres (1 yard = ·9144 metres) are there in 4 miles?

4 miles = 1760 yds. × 4 = 7040 yds.
= (·9144 × 7040) metres.
= 6437·376 metres. Ans.

$$\begin{array}{r} ·9144 \\ 7040 \\ \hline 365760 \\ 64008 \\ \hline 6437·3760 \end{array}$$

13. If 20 men can mow a field of 7 acres 3 roods in $8\frac{1}{2}$ days of 10 hours each, how many fields of half the area can 255 men mow in 10 days of 8 hours each?

Half the area of $7\frac{3}{4}$ ac. $= 7\frac{3}{4}$ ac. $\div 2 = 3\frac{7}{8}$ ac.
$8\frac{1}{2}$ days of 10 hrs. each $= (10 \times 8\frac{1}{2})$ hrs. $= 85$ hrs.
10 days of 8 hrs. each $= (8 \times 10)$ hrs. $= 80$ hrs.

20 : 255 :: $7\frac{3}{4}$ ac.
85 : 80

Area mowed $= 7\frac{3}{4}$ ac. $\times \frac{3}{\cancel{255}} \times \frac{\overset{4}{\cancel{80}}}{\cancel{85} \times \cancel{20}} = 93$ ac.

No. of fields of half the area which can be mowed by 255 men in the given time

$$= 93 \div 3\tfrac{7}{8} = \frac{93 \times 8}{31} = 3 \times 8 = 24.$$

14. At what rate per cent. will £2,710 produce £569 2s., simple interest, in 6 years?

Interest on £2,710 for 6 years = £$569\frac{1}{10}$.
,, £2,710 for 1 year = £$569\frac{1}{10} \div 6$.
,, £1 for 1 year = £$\frac{569\frac{1}{10} \div 6}{2710}$.
,, £100 for 1 year = £$\frac{569\frac{1}{10} \div 6 \times 100}{2710}$

$$= £\frac{5691 \div 6}{271} = £21 \div 6 = £3\tfrac{1}{2}.$$

Rate of interest = $3\frac{1}{2}$ per cent.

SECTION III.

15. Four bells, which commence tolling together, toll at intervals of 1·2, 1·75, 1·8, and 2·1 seconds, respectively; at what intervals will they toll together?

Express the intervals of tolling as improper fractions in their lowest terms.

These equal respectively $\frac{6}{5}$, $\frac{7}{4}$, $\frac{9}{5}$, $\frac{21}{10}$.

The least number of seconds after which these will toll together again is the L.C.M. of 6, 7, 9, and 21, which = 126.

$$3 \mid 6,\ 7,\ 9,\ 21$$
$$2,\quad 3,\ 7$$

L.C.M. $= 3 \times 2 \times 3 \times 7 = 126$.

They will therefore toll together at intervals of 126 seconds.

16. Find the number of hours from noon on May 1st, 1895, to noon on March 1st, 1896.

30½ May, 1895.
30 June, 1895.
31 July, 1895.
31 August, 1895.
30 September, 1895.
31 October, 1895.
30 November, 1895.
31 December, 1895.
31 January, 1896.
29 February, 1896.
½ March, 1896.

305 = total No. of days.

No. of hours $= 305 \times 24$
$= 7320$.

17. A man invests £20,000 in 2¾ per cent. consols at 102; what is his income after deducting income tax at 8d. in the £?

Income from an investment of £102 $= £\frac{11}{4}$.
" " " £1 $= £\frac{11}{4} \times \frac{1}{102}$.
" " " £20,000

$$= £\frac{11 \times 20{,}000}{4 \times 102}.$$

Each pound of gross income, after deducting tax, $= £\frac{19}{20}$.

∴ Income after deducting tax

$$= £\frac{11 \times \overset{250}{\cancel{20000}} \times 19}{\underset{51}{\cancel{4} \times \cancel{102} \times \cancel{30}}} = £\frac{79750}{153}$$

$= £521\ 4s.\ 10\frac{3}{51}d.$

£ £ s. d.
153) 79750 (521 4 $10\frac{3}{51}$
705
325
306
190
153
37
20
153) 740 (4s.
612
128
12
153) 1536 ($10\frac{6}{153}$d. $= 10\frac{2}{51}$d.
1530
6

18. The average weight of the 8 oarsman in a boat is increased by 2½ lbs. when one of the crew, who weighs 11 stones 12 lbs., is replaced by a new man. What is the weight of the new man?

Total increase of weight of the crew $= 2\frac{1}{2}$ lbs. $\times 8 = 1$ st. 6 lbs.

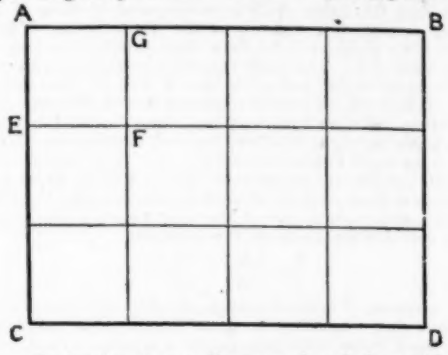
The whole of this increase is due to the introduction of the new man.

Therefore the weight of the new man equals 11 stones 12 lbs. + 1 stone 6 lbs. = 13 stones 4 lbs.

19. The length of a field of 50 acres is to its breadth as 4 : 3. Find the length to the nearest tenth of a yard.

50 ac. = 4,840 sq. yds. $\times 50$
= 242,000 sq. yds.

Let the field be represented by the figure ABCD, which is 4 in. long and 3 in. broad. Its area = 4 in. $\times$ 3 in. = 12 sq. in. By drawing lines at distances of an inch parallel to the opposite sides it may be divided into 12 equal squares, each having an area of 1 sq. inch. Thus the figure AEFG = $\frac{\text{total area}}{12}$. The side AE = square root of the area of the figure AEFG; ∴ AE $= \sqrt{\frac{\text{area}}{12}}$. But the breadth AC = 3AE, and the length AB = 4AE.



∴ Length $= 4\sqrt{\frac{\text{area}}{12}}$.

Breadth $= 3\sqrt{\frac{\text{area}}{12}}$.

$\frac{\text{area}}{12} = \frac{242000 \text{ sq. yds.}}{12} = 20166{\cdot}66$, etc., sq. yds.

$\sqrt{\frac{\text{area}}{12}} = \sqrt{20166{\cdot}66}$ sq. yds. = 142·00, etc., lineal yds.

20166·66 (142·00
1
24) 101
96
282) 566
564
28400) 26600

Length = 142 yds. $\times 4 = 568$ yds.
Breadth = 142 yds. $\times 3 = 426$ yds.

20. A sells a horse to B at a loss of 10 per cent.; B resells the horse to A at a gain of 10 per cent.; what percentage of the original cost has A gained or lost by the double transaction?

Suppose the original cost of the horse was £100.
A sells the horse to B for £90.
B resells the horse to A at a gain of 10 p.c.
He therefore sells the horse to A for
£90 + 10 p.c. of £90.
£90 + £9 = £99.
A therefore loses £99 − £90 = £9.
Since the original cost of the horse was £100, he loses 9 per cent.

21. A postage stamp is $\frac{33}{4}$ in. long and $\frac{4}{5}$ in. wide; how many will be required to cover a board 1 ft. 11 in. long and 1 ft. wide?

Area of one postage stamp
$= \frac{33}{4}$ in. $\times \frac{4}{5}$ in. $= \frac{33}{5}$ sq. in.
Area of board
= 1 ft. 11 in. $\times$ 1 ft.
= 23 in. $\times$ 12 in. = 276 sq. in.
Number of postage stamps required
$= 276 \div \frac{33}{5}$

$$= \frac{\overset{12}{\cancel{276}}}{\underset{23}{\cancel{33}}} \times 30 = 360.$$

22. A box (without a lid), made of wood an inch thick, measures on the outside 30 in. long, 21 in. wide, and 16 in. deep; find the cubic contents of the interior, and the cost of painting the outside at 7d. per sq. ft.

Inside length = 30 in. − 2 in. = 28 in.
Inside breadth = 21 in. − 2 in. = 19 in.
Inside depth = 16 in. − 1 in. = 15 in.
Cubic contents of interior
= 28 in. $\times$ 19 in. $\times$ 15 in. = 7980 cubic inches.

The exterior has five faces :—

Area of back and front, each,
= length × depth = 30 in. × 16 in. = 480 sq. in.

Area of sides, each,
= breadth × depth = 21 in. × 16 in. = 336 sq. in.

Area of bottom
= length × breadth = 30 in. × 21 in. = 630 sq. in.

Total area of exterior
= (480 sq. in. × 2) + (336 sq. in. × 2) + 630 sq. in.
= 960 sq. in. + 672 sq. in. + 630 sq. in.
= 2262 sq. in.

Cost of painting 144 sq. in. = 7d.

,, ,, 1 sq. in. = $\frac{7}{144}$ d.

,, ,, 2262 sq. in. = $\frac{7 \times 2262}{144}$ d.

$= \frac{7 \times 377}{24}$ d. $= \frac{2639}{24}$ d. $= 109\frac{23}{24}$ d.

= 9s. $1\frac{23}{24}$ d.

ALTERNATIVE QUESTIONS ON ALGEBRA—

WOMEN ONLY.

Any of these questions may be answered instead of the same number of questions in Arithmetic.

1. (*a*) Prove the rule for subtracting algebraical quantities.

(*b*) Simplify

$$4\{3a - 2(b - c + a)\} - [6a - \{2c - (5b - 4a)\}]$$

(*a*) Supposing we had to take b from a. The result is $a - b$. Now suppose we had to take $b - c$ from a. As we are taking from a a quantity which is c less than the original quantity we subtracted, it is evident that our result must be c more than the original result.

But the original result was $a - b$.

Therefore, when we subtract $b - c$ from a, the result is $a - b + c$, or a minus $(b - c) = a - b + c$.

But the original sign of the quantity b was +, since no sign preceded it, and the original sign of the quantity c was −. In the result, these signs, which are the signs of the quantity to be subtracted, have been respectively altered, and the result added to a.

(*b*) $4\{3a - 2(b - c + a)\} - [6a - \{2c - (5b - 4a)\}]$
$= 4\{3a - 2b + 2c - 2a\} - [6a - 2c + (5b - 4a)]$
$= 4\{3a - 2b + 2c - 2a\} - [6a - 2c + 5b - 4a]$
$= 12a - 8b + 8c - 8a - 6a + 2c - 5b + 4a$
$= 2a - 13b + 10c$.

2. (*a*) Show that $(-a) \times (-b) = +ab$, where a and b represent any numbers.

(*b*) Multiply $5x^2 - 6xy + 7y^2$ by $7x^2 + 6xy - 5y^2$.

(*a*) We assume in the answer to this question that brackets have been already studied.

Suppose we had to multiply $m - a$ by $n - b$. We may represent the operation to be performed thus—

$$(m - a)(n - b).$$

This equals—

$$m(n - b) - a(n - b) = mn - nb - an + ab.$$

Here we see that the result of the multiplication of $-a$ by $-b = ab$.

(*b*)
$$\begin{array}{l} 5x^2 - 6xy + 7y^2 \\ 7x^2 + 6xy - 5y^2 \\ \hline 35x^4 - 42x^3y + 49x^2y^2 \\ \quad + 30x^3y - 36x^2y^2 + 42xy^3 \\ \quad\quad - 25x^2y^2 + 30xy^3 - 35y^4 \\ \hline 35x^4 - 12x^3y - 12x^2y^2 + 72xy^3 - 35y^4 \end{array}$$

3. (*a*) Prove that $a^7 \div a^5 = a^2$.

(*b*) Divide

$27x^3y^3 - 63x^2y^2$ by $9x^2y^2$, and $a^2 - b^2 + 2ac - 2bc$ by $a - b$.

(*a*) $a^7 = a \times a \times a \times a \times a \times a \times a$;
$a^5 = a \times a \times a \times a \times a$;

$$a^7 \div a^5 = \frac{a \times a \times a \times a \times a \times a \times a}{a \times a \times a \times a \times a}.$$

Here each of the factors in the denominator cancels one factor in the numerator. There will be left, therefore, in the numerator two factors, each equal to a.

$$\therefore \frac{a \times a \times a \times a \times a \times a \times a}{a \times a \times a \times a \times a} = a \times a = a^2.$$

(*b*)
$$\begin{array}{l} 9x^2y^2) \; 27x^3y^3 - 63x^2y^3 \; (3xy - 7 \\ \quad\quad 27x^3y^3 \\ \hline \quad\quad\quad - 63x^2y^3 \\ \quad\quad\quad - 63x^2y^3 \\ \hline \end{array}$$

$$\begin{array}{l} a - b) \; a^2 - b^2 + 2ac - 2bc \; (a + b + 2c \\ \quad a^2 - ab \\ \hline \quad\quad ab - b^2 + 2ac - 2bc \\ \quad\quad ab - b^2 + 2ac - 2bc \\ \hline \end{array}$$

Answers. $3xy - 7$; $a + b + 2c$.

4. Solve the equations :—

(*a*) $3(x - 7) - 7(x - 3) + 5(3x - 15) = 2(8 - x)$;

(*b*) $\frac{5x}{2} - \frac{3}{7} = 17\frac{4}{7} - \left(\frac{x}{2} - 12\right)$;

(*c*) $\frac{x - 2}{x - 1} + \frac{x - 3}{x - 2} = 2$.

(*a*) $3(x - 7) - 7(x - 3) + 5(3x - 15) = 2(8 - x)$;
$\therefore 3x - 21 - 7x + 21 + 15x - 75 = 16 - 2x$;
$\therefore 3x - 7x + 15x + 2x = 16 + 75$;
$\therefore 13x = 91$;
$\therefore x = 7$.

(*b*) $\frac{5x}{2} - \frac{3}{7} = 17\frac{4}{7} - \left(\frac{x}{2} - 12\right)$;

$$\therefore \frac{5x}{2} - \frac{3}{7} = 17\frac{4}{7} - \frac{x}{2} + 12.$$

Multiply all terms by 14 ;
$\therefore 35x - 6 = 246 - 7x + 168$;
$\therefore 35x + 7x = 6 + 246 + 168$;
$\therefore 42x = 420$;
$\therefore x = 10$.

(*c*) $\frac{x - 2}{x - 1} + \frac{x - 3}{x - 2} = 2$.

Divide numerators by denominators ;

$$\therefore 1 - \frac{1}{x - 1} + 1 - \frac{1}{x - 2} = 2.$$

Whole numbers cancel on each side ;

$$\therefore -\frac{1}{x - 1} - \frac{1}{x - 2} = 0.$$

Multiply all terms by $(x - 1)(x - 2)$;
$\therefore -(x - 2) - (x - 1) = 0$;
$\therefore -x + 2 - x + 1 = 0$;
$\therefore -2x = -3$;
$\therefore x = 1\frac{1}{2}$.

5. Divide eighteen shillings among four girls so that the eldest may receive two shillings more than the second, the second two shillings more than the third, and the third two shillings more than the fourth.

Let x = number of shillings the fourth girl receives.
Then $x + 2$ = ,, ,, ,, third ,,
$x + 4$ = ,, ,, ,, second ,,
And $x + 6$ = ,, ,, ,, first ,,
$\therefore x + x + 2 + x + 4 + x + 6 = 18$;
$\therefore 4x + 12 = 18$;
$\therefore 4x = 18 - 12$
$= 6$;
$\therefore x = 1\frac{1}{2}$;
= 1s. 6d. fourth girl.

Ans. Eldest girl, 7s. 6d.; second, 5s. 6d.; third, 3s. 6d.; fourth, 1s. 6d.

6. What does an egg cost when a rise of 20 per cent. in the price would make a difference of 48 in the number which could be bought for thirty shillings ?

20 per cent. = $\frac{1}{5}$, 30s. = 360 pence.
Let x = original cost of an egg in pence.
Then $\frac{6x}{5}$ = increased cost of an egg in pence.

$\frac{360}{x}$ = number of eggs bought for thirty shillings at the original price.

And $\frac{360}{\frac{6x}{5}}$ = number of eggs bought for thirty shillings at the increased price.

$$\therefore \frac{360}{x} - \frac{360}{\frac{6x}{5}} = 48;$$

$$\therefore \frac{360}{x} - \frac{1800}{6x} = 48.$$

Multiply all terms by x;

$$\therefore 360 - 300 = 48x;$$
$$\therefore 48x = 60;$$
$$\therefore x = 1\tfrac{1}{4}.$$

Ans. An egg costs $1\frac{1}{4}$d.

ALGEBRA AND MENSURATION—MEN.

Friday, December 20, 10 to 12.

Answer SEVEN *questions on Algebra, and* ONE *question on Mensuration.*

If you answer more than the prescribed number of questions, only the prescribed number of answers coming first on your paper will be revised.

1. Explain clearly, as to a class beginning algebra, the reason for the sign in the result of the multiplication of—

(*a*) A negative quantity by a positive quantity.
(*b*) A negative quantity by a negative quantity.

(*a*) Suppose we have to take n from m, the result is $m - n$. If now we diminish the number we subtract by p, we have to take $n - p$ from m. Our result will evidently be p more than when we took the greater number n from m. So that

$$m - (n - p) = m - n + p.$$

We thus learn that to take quantities out of brackets when a minus sign precedes the bracket, we must alter the signs of all the terms inside.

(*b*) Suppose, now, we have to multiply $a - b$ by $c - d$. The result of multiplying $a - b$ by a compound quantity like $c - d$ is the result obtained when we multiply by the terms of the multiplier separately, and add algebraically the separate products obtained. Thus 13 multiplied by

$$(6 - 3) = (13 \times 6) - (13 \times 3).$$

So

$$(a - b)(c - d) = a(c - d) - b(c - d) = ac - ad - bc + bd.$$

Here we see that $-d \times +a = -ad$; $-b \times +c = -bc$; and $-b \times -d = +bd$.

2. (*a*) Find the conditions that the roots of $mx^2 + nx + c = 0$ may be real and positive.

(*b*) Solve $10(x^2 - 1) = 21x$.

(*a*) $$mx^2 + nx + c = 0.$$

Divide all terms by m;

$$\therefore x^2 + \frac{n}{m}.x + \frac{c}{m} = 0.$$

$$\text{And } x^2 + \frac{n}{m}.x = -\frac{c}{m}.$$

Add to each side the square of $\frac{n}{2m}$.

$$\therefore x^2 + \frac{n}{m}.x + \left(\frac{n}{2m}\right)^2 = \frac{n^2}{4m^2} - \frac{c}{m} = \frac{n^2 - 4cm}{4m^2}.$$

Extract the square root of each side;

$$\therefore x + \frac{n}{2m} = \frac{\pm\sqrt{n^2 - 4cm}}{2m}.$$

$$\therefore x = -\frac{n}{2m} \pm \frac{\sqrt{n^2 - 4cm}}{2m}.$$

If the roots are to be *real*, $4cm$ must be less than n^2. If it were not, then $n^2 - 4cm$ would be a *negative* quantity, and it is impossible to extract the square root of a negative quantity.

Now $\frac{\sqrt{n^2 - 4cm}}{2m}$ must be less than $\frac{n}{2m}$, for this equals $\frac{\sqrt{n^2}}{2m}$, and $\sqrt{n^2 - 4cm}$ is less than $\sqrt{n^2}$. Then if each of the roots of the equation is to be positive, $-\frac{n}{2m}$ must be a positive quantity. Since it is greater than $\frac{\sqrt{n^2 - 4cm}}{2m}$, the result is positive, whether this latter be added to or subtracted from it. To make $-\frac{n}{2m}$ positive, it is evident that m and n must be quantities of opposite sign.

(*b*) $$10(x^2 - 1) = 21x.$$
$$\therefore 10x^2 - 21x - 10 = 0.$$

Factorise—

$$\therefore (5x + 2)(2x - 5) = 0; \therefore 5x + 2 = 0;$$
$$\therefore 5x = -2; \text{ and } x = -\tfrac{2}{5}.$$
$$\text{And } 2x - 5 = 0; \therefore 2x = 5, \text{ and } x = 2\tfrac{1}{2}.$$

3. Prove that $x - 1$ is a factor of

$$77(x - 1)(x - 98)^2 + x^3 - 100x^2 + 197x - 98,$$

and hence find the other factors.

$$\begin{aligned}
&77(x - 1)(x - 98)^2 + x^3 - 100x^2 + 197x - 98 \\
&= 77(x - 1)(x - 98)^2 + x^3 - x^2 - (99x^2 - 197x + 98) \\
&= 77(x - 1)(x - 98)^2 + x^2(x - 1) - (x - 1)(99x - 98) \\
&= (x - 1)\{77(x - 98)^2 + (x^2 - 99x + 98)\} \\
&= (x - 1)\{77(x - 98)^2 + (x - 98)(x - 1)\} \\
&= (x - 1)[(x - 98)\{77(x - 98) + (x - 1)\}] \\
&= (x - 1)[(x - 98)\{78x - 7547\}] \\
&= (x - 1)(x - 98)(78x - 7547).
\end{aligned}$$

4. Put each of the following into factors :—

$x^2 - 7x + 12$, $8x^3 - 27$, $4x^2 - 13x + 10$, $2x^2 - 7x + 6$;

and hence find the L.C.M. of these four expressions.

$$x^2 - 7x + 12 = (x - 4)(x - 3).$$
$$8x^3 - 27 = (2x - 3)(4x^2 + 6x + 9).$$
$$4x^2 - 13x + 10 = (4x - 5)(x - 2).$$
$$2x^2 - 7x + 6 = (2x - 3)(x - 2).$$

Since the factors of the last quantity have appeared in former quantities, we shall not need them.

Hence the L.C.M.

$$= (x - 4)(x - 3)(2x - 3)(4x^2 + 6x + 9)(4x - 5)(x - 2)$$
$$= (x^2 - 7x + 12)(8x^3 - 27)(4x^2 - 13x + 10).$$

5. The volume of a perfect cube is

$x^6 - 21x^5 + 150x^4 - 385x^3 + 150x^2 - 21x + 1$ in cubic inches.

Find the length of one edge.

Prove that the surface is 6 square inches if $x = 7$.

The length of one edge is the cube root of the volume.

$$\begin{array}{r|l}
x^6 - 21x^5 + 150x^4 - 385x^3 + 150x^2 - 21x + 1 & 3x^2 - 7x \\
x^6 & \\
\hline
-21x^5 + 150x^4 - 385x^3 & \\
-21x^5 + 147x^4 & -7x(3x^2 - 7x) \\
\hline
3x^4 - 385x^3 & 3x^4 - 21x^3 + 49x^2 \\
3x^4 - 343x^3 & \\
\hline
-42x^3 + 150x^2 - 21x + 1 & 3x^2 - 21x + 1 \\
-42x^3 + 150x^2 - 21x + 1 & \\
\hline
0 &
\end{array}$$

Length of one edge = $(x^2 - 7x + 1)$ inches.

If $x = 7$, then $x^2 - 7x + 1 = 49 - 49 + 1 = 1$. That is, the length of one edge is 1 inch.

The surface of the cube consists of 6 equal square faces, each having a side of 1 inch. The surface of each face is therefore $(1)^2$ square inches, or 1 square inch, and the surfaces of the six faces six square inches.

6. A train travels from A to B. If it had travelled 5 miles an hour slower, it would have taken an hour longer, while it would have taken an hour less if it had travelled 7 miles an hour faster. Find the distance from A to B, and the speeds.

Let x = distance from A to B in miles.

y = original speed of train in miles per hour.

Then $\frac{x}{y}$ = number of hours train takes to go from A to B.

Then $$\frac{x}{y-5} = \frac{x}{y} + 1. \quad (1)$$

And $$\frac{x}{y+7} = \frac{x}{y} - 1. \quad (2)$$

In equation (1) multiply all terms by $y(y-5)$.

Then $xy = x(y-5) + y(y-5)$;

$\therefore xy = xy - 5x + y^2 - 5y$;

$\therefore 5x = y^2 - 5y$,

and $x = \frac{y^2 - 5y}{5}$.

Now subtract equation (2) from equation (1).

Then $$\frac{x}{y-5} - \frac{x}{y+7} = 2.$$

Multiply all terms by $(y-5)(y+7)$.

$x(y+7) - x(y-5) = 2(y-5)(y+7)$.

$xy + 7x - xy + 5x = 2(y-5)(y+7)$.

$\therefore 12x = 2(y-5)(y+7)$.

$$x = \frac{(y-5)(y+7)}{6}.$$

Equate this with the value of x already found in terms of y.

$$\therefore \frac{(y-5)(y+7)}{6} = \frac{y(y-5)}{5}.$$

Divide both sides by $(y-5)$, and multiply all terms by 30.

$\therefore 6y = 5(y+7)$.

$\therefore y = 35$ miles per hour.

$$x = \frac{y^2 - 5y}{5} = \frac{1225 - 175}{5} = 210 \text{ miles.}$$

Ans. Distance = 210 miles; speed = 35 miles per hour.

7. Solve

(*a*) $$\frac{3}{x} + \frac{5}{y} = 19,$$

$$\frac{7}{x} - \frac{9}{y} = 3;$$

(*b*) $(x^2 + x + 1)^2 - 4(x^2 + x - 1) - 5 = 0$;

(*c*) $$\frac{x}{a} + \frac{y}{b} = 2ab = \frac{x}{b} + \frac{y}{a}.$$

(*a*) $\frac{3}{x} + \frac{5}{y} = 19$ (i); $\frac{7}{x} - \frac{9}{y} = 3$ (ii).

Multiply all terms in (i) by 7, and in (ii) by 3;

$$\therefore \frac{21}{x} + \frac{35}{y} = 133 \text{ (i)}$$

Subtract, $$\frac{21}{x} - \frac{27}{y} = 9 \text{ (ii)}$$

$$\therefore \frac{62}{y} = 124.$$

Divide by 62, $\therefore \frac{1}{y} = 2.$

Multiply by y, $\therefore 1 = 2y$ and $y = \frac{1}{2}$.

Substitute this value in equation (i).

$$\therefore \frac{3}{x} + \frac{5}{\frac{1}{2}} = 19,$$

$$\therefore \frac{3}{x} + 10 = 19.$$

Multiply all terms by x;

$\therefore 3 + 10x = 19x$,

$\therefore 19x - 10x = 3$,

$\therefore 9x = 3$ and $x = \frac{1}{3}$.

(*b*) $(x^2 + x + 1)^2 - 4(x^2 + x - 1) - 5 = 0$.

$\therefore (x^2 + x)^2 + 2(x^2 + x) + 1 - 4(x^2 + x) + 4 - 5 = 0$.

$\therefore (x^2 + x)^2 - 2(x^2 + x) = 0$.

Divide all terms by $(x^2 + x)$,

$\therefore (x^2 + x) - 2 = 0$. (A)

Since $x^2 + x$ divides all terms,

$\therefore x^2 + x = 0$.

Divide all terms by x;

$\therefore x = 0$,

and $ax + 1 = 0$ and $x = -1$.

By (A) $x^2 + x - 2 = 0$.

Factorise,

$\therefore (x + 2)(x - 1) = 0$.

$\therefore x + 2 = 0$, and $x = -2$.

$x - 1 = 0$, and $x = 1$.

Ans. $x = 0, 1, -1$, and -2.

(*c*) $$\frac{x}{a} + \frac{y}{b} = 2ab, \quad \text{(i)}$$

$$\frac{x}{b} + \frac{y}{a} = \frac{x}{a} + \frac{y}{b}. \quad \text{(ii)}$$

Multiply all terms in (ii) by ab;

$\therefore ax + by = bx + ay$.

$\therefore x(a - b) = y(a - b)$.

$\therefore x = y$.

Substitute this value for x in equation (i);

$$\therefore \frac{y}{a} + \frac{y}{b} = 2ab.$$

Multiply all terms by ab;

$\therefore by + ay = 2a^2b^2$.

$$\therefore y = \frac{2a^2b^2}{a + b}.$$

Since $x = y$, $x = \frac{2a^2b^2}{a + b}$.

8. Find the value of (*a*)

$(a + b + c)^3 - (a + b - c)^3 + (a - b + c)^3 + (-a + b + c)^3 - 24abc$, when $2a = 2 = -2b = c$;

and (*b*) simplify,

$$\frac{1}{x+1} - \frac{1}{x-1} + \frac{2}{x^2+1} + \frac{4}{x^4+1} + \frac{8}{x^8+1}.$$

(*a*) $2a = 2$, $\therefore a = 1$.

$-2b = 2$, $\therefore b = -1$.

and $c = 2$.

$\therefore (a + b + c)^3 - (a + b - c)^3 + (a - b + c)^3 + (-a + b + c)^3 - 24abc$.

$= (1 - 1 + 2)^3 - (1 - 1 - 2)^3 + (1 + 1 + 2)^3 + (-1 - 1 + 2)^3 - (24 \times 1 \times -1 \times 2)$

$= (2)^3 - (-2)^3 + (4)^3 + (0)^3 - (-48)$.

$= 8 + 8 + 64 + 48 = 128$.

$$(b)\quad \frac{1}{x+1}-\frac{1}{x-1}+\frac{2}{x^2+1}+\frac{4}{x^4+1}+\frac{8}{x^8+1}$$

$$=\frac{(x-1)(x^2+1)(x^4+1)(x^8+1)-(x+1)(x^2+1)(x^4+1)(x^8+1)+2(x+1)(x-1)(x^4+1)(x^8+1)+4(x+1)(x-1)(x^2+1)(x^8+1)+8(x+1)(x-1)(x^2+1)(x^4+1)}{(x+1)(x-1)(x^2+1)(x^4+1)(x^8+1)}.$$

Place common factors of the first three terms outside a bracket.

$$=\frac{(x^4+1)(x^8+1)\{(x-1)(x^2+1)-(x+1)(x^2+1)+2(x+1)(x-1)\}+4(x^4-1)(x^8+1)+8(x^8-1)}{x^{16}-1}$$

$$=\frac{(x^4+1)(x^8+1)\{(x^3-x^2+x-1)-(x^3+x^2+x+1)+2(x^2-1)\}+4(x^{12}-x^8+x^4-1)+8(x^8-1)}{x^{16}-1}$$

$$=\frac{(x^4+1)(x^8+1)\{x^3-x^2+x-1-x^3-x^2-x-1+2x^2-2\}+4(x^{12}-x^8+x^4-1)+8(x^8-1)}{x^{16}-1}$$

$$=\frac{-4(x^{12}+x^8+x^4+1)+4(x^{12}-x^8+x^4-1)+8(x^8-1)}{x^{16}-1}$$

$$=\frac{-4x^{12}-4x^8-4x^4-4+4x^{12}-4x^8+4x^4-4+8x^8-8}{x^{16}-1}$$

$$=-\frac{16}{x^{16}-1}.$$

9. A second standard is told to find the number of children in a school, and is given the number of boys and of girls. One child, multiplying, obtains 11,424, while another subtracts, and gives as answer 52; what is the correct answer?

Let x = correct number of the sex constituting the majority of the scholars.

y = correct number of other sex.

Then $xy = 11424$, (i)

And $x - y = 52$. (ii)

By ii. $x = 52 + y$.

Substitute this value in (i);

$\therefore y(52+y) = 11424$,

$\therefore y^2 + 52y = 11424$.

Complete square,

$\therefore y^2 + 52y + (26)^2 = 11424 + 676$

$= 12100$.

Extract square root,

$\therefore y + 26 = 110$.

And $y = 110 - 26 = 84$,

$x = 52 + y = 84 + 52$

$= 136$.

Number of children in the school

$= 136 + 84 = 220$.

MENSURATION.

(*Assume* $\pi = \frac{22}{7}$.)

10. A bite has been taken out of a circular biscuit $3\frac{1}{2}$ inches in diameter, the edge of the hole is found to be an exact semicircle $1\frac{3}{4}$ inches in diameter. What is the area of the piece bitten out?

Let BEC represent the edge of the hole.

Join BC. Then BC $= 1\frac{3}{4}$ inches = BA or AC.

The piece bitten out = the semicircle BEC + the segment of the circle BFC. Join AB, AC.

Then the area of the segment BFC = area of the sector ABFC — area of equilateral triangle ABC. But since sector ABFC subtends an angle of 60° at the centre, its area = $\frac{1}{6}$ area of the circle BFCD

$= \frac{1}{6} \times \frac{22}{7} \times (\frac{7}{4})^2 = \frac{1}{6} \times \frac{22}{7} \times \frac{49}{16} = \frac{77}{48}$ sq. in.

And area of equilateral triangle

$= (\frac{7}{4})^2 \times \sqrt{3} = \frac{49}{16} \times 1{\cdot}73$

$= \frac{84{\cdot}77}{64} = 1{\cdot}324$ sq. in. $= 1\frac{81}{250}$ sq. in.

$\therefore$ Area of segment BFC

$= \frac{77}{48}$ sq. in. $- 1\frac{81}{250}$ sq. in.

$= \frac{9625 - 7944}{6000} = \frac{1681}{6000}$ sq. in.

Then area of piece of bitten out = area of semicircle BEC + area of segment BFC

$= \frac{22}{7} \times \frac{1}{2} \times (\frac{7}{4})^2 + \frac{1681}{6000} = \frac{77}{44} + \frac{1681}{6000}$

$= \frac{28875 + 6724}{24000}$ sq. in. $= \frac{35599}{24000}$ sq. in.

$= 1\frac{11599}{24000}$ sq. in.

11. In a schoolroom 77 feet long and 32 feet wide, there is a raised platform with straight sides and back and a semicircular front. The length of each straight portion of the platform is 10 feet. Find the area of the floor not occupied by the platform.

Area of schoolroom

$= 77$ ft. $\times 32$ ft. $= 2464$ sq. ft.

The rectangular portion of the platform occupies on the floor space a square each of whose sides is 10 ft.

∴ Area occupied by this portion of the platform

$= 10 \text{ ft.} \times 10 \text{ ft.} = 100 \text{ sq. ft.}$

The front portion of the platform occupies a semicircle on the floor, whose diameter is 10 ft., or radius 5 ft.

Since area of semicircle $= \frac{\pi r^2}{2}$, area of floor occupied by front of platform

$$= \frac{22}{7} \times \frac{(5)^2}{2} = \frac{22 \times 25}{7 \times 2}$$

$= 39\frac{3}{7}$ sq. ft. $= 39\frac{3}{7}$ sq. ft.

∴ Total area of floor occupied by platform

$= 100$ sq. ft. $+ 39\frac{3}{7}$ sq. ft. $= 139\frac{3}{7}$ sq. ft.

∴ Area of floor not occupied by platform

$= 2464$ sq. ft. $- 139\frac{3}{7}$ sq. ft. $= 2324\frac{5}{7}$ sq. ft.

(To be continued.)

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Head Master of the Belvedere Pupil Teachers' Centre, First on Scholarship List, Author of 'Scholarship School Management.'

PUPIL TEACHERS' COURSE.

SCHEME OF WORK FOR THE MONTH.

WORK TO BE PREPARED.

A.—*English.*

First Year.

1. The Adjective. Prepare a good classification such as:—

Adjective { Quantity { Definite { Cardinal / Ordinal } / Indefinite } / Quality / Demonstrative }

Degrees of comparison.—Note that Adjectives of Quality only (with some few of Indefinite Quantity) can be compared. Learn the irregular, comparative, and superlative forms.

2. Learn the meaning and use of the following suffixes:—
-able, -ible, -ble, -al, -ant, -ent, -ic, -id, -il, -eal, -le, -ine, -lent, -ose, -ous, -und, -ulous.

3. Learn 10 roots and meanings per week.

Second Year.

1. The Adverb, classification and uses.

2. Learn the Greek Prefixes.

3. Learn 15 roots and meanings each week.

Third Year.

1. English Literature. The chief writers and their works from 1603 to 1625 A.D. A brief life of each writer, his chief works, and a few words descriptive of them should be entered in a note book and carefully committed to memory.

2. Learn 20 roots and meanings each week.

3. Learn the following :—
How to distinguish English words from those of foreign origin.

It is not possible to frame rules which will serve in every instance to distinguish Saxon words from those of Latin, Greek, or Norman-French origin, but by attention to the following points the great majority can with tolerable certainty be recognised:—

1. Words which are inflected internally are generally Saxon :—Nouns which form the plural by vowel change, as man, foot, goose ; Verbs that are *strong*, as write, speak, etc.

2. The greater part of monosyllabic words are of native origin.

3. The Auxiliary Verbs, Pronouns, Conjunctions, Prepositions, and Adverbs are nearly all Saxon.

4. Words with English suffixes are usually English; with Latin suffixes Latin, etc., although there are many examples of hybrid words where the root is from one language and the suffix from another.

5. The common words relating to the house and home, agricultural operations, simple actions, etc., are Saxon, but the generic and abstract words are mainly foreign. Thus *father, mother, sister, brother* are Saxon, but *relative* is Latin; *white, blue, red* are Saxon, *colour* is Latin ; *plough, sow, reap, bind, dig* are Saxon, *agriculture* is Latin.

6. Certain combinations of letters usually distinguish a word as Saxon, as—
wh—e.g., who, what, which, where, when.
kn—e.g., know, knight, knock.
gh—e.g., though, through, trough, etc.

B.—*Arithmetic.*

First Year.

Boys. — Lock. Work Examples LIX. (general examples on Fractions).

Some of these examples involve the finding of G.C.M. and L.C.M. of Fractions. Note therefore the following rules :—

1. *To find the G.C.M. of two or more Fractions :*—
Find the G.C.M. of the given numerators for the numerator, and the L.C.M. of the denominators for the denominator.

2. *To find the L.C.M. of two or more Fractions:*—
Find the L.C.M. of the given numerators for the numerator, and the G.C.M. of the given denominators for the denominator.

Girls.—Dixon and Beach. Read Chapter XI., and work Example XI.

Second Year.

Boys.—Lock. Work Examples CXIV.–CXVII. Read carefully the explanations, and study the model solutions of problems on Time and Distance, and Time and Work. They are of very frequent occurrence.

Girls.—Dixon and Beach. Read Chapters XXIII., XXIV., and work the Examples thereon.

Third Year.

Boys. — Lock. Work Examples CXXXV., CXXXVI., Stocks. Study the model solutions given.

Girls.—Dixon and Beach. Read carefully Chapters XXV., XXVI., and work Examples thereon.

The problems on the work of mixed agents are important. They frequently appear in examination papers.

N.B.—The greatest attention should be paid to the method and arrangement of sums. Neatness and lucidity are of immense importance.

C.—*Music.*

First Year.
Second Year.
Third Year.

The whole of the work set by syllabus in this subject should now have been completed. A complete set of questions will be given each month for practice. No marks should be lost on this subject.

The *practical work* must not be neglected. Abundant exercises of all kinds will be found in 'Practical Music for Pupil Teachers' (Curwen & Sons. Price 6d.).

D.—*Spelling.*

Learn 200 words from 'Words Commonly Misspelt' (1st Series), or any good list. Test frequently by dictation.

E.—*Geography.*—AUSTRO-HUNGARY, TURKEY, GREECE, AND THE BALKAN STATES.

Austro-Hungary.—Chief points :—

The Empire is made up of two distinctive parts, the Empire of Austria and the Kingdom of Hungary. Each has its own laws and form of government, but the Emperor of Austria is also King of Hungary.

Coast line very small compared with extent of the country ; therefore few ports and comparatively small trade with other countries by sea.

Relief.—The western provinces, mainly mountainous ; The Tyrol, etc. Mountains: Alps—Rhætian and Dinaric, Bohmer Wald, Erz Gebirge, Riesen Gebirge, Sudetic, and Little Carpathians, enclosing the plain of Bohemia, the Carpathian and Transylvanian Alps, sweeping round the great plain of Hungary.

Rivers.—The upper courses of the Elbe, Vistula, Dniester, and Pruth ; but the greater part of the country is drained by the Danube and its tributaries—Inn, Raab, Drave, and Save on the right bank, and the March, Waag, Theiss, and Pruth on the left. The course of the Danube must be carefully prepared, and a map of its basin prepared.

The *Climate* varies very much with locality, and is largely affected by the disposition of the various maintain chains.

Productions :—

Animal—As in other countries of Central Europe ; the bear, wolf, stag, and other wild animals are found in the forest-clad Carpathians. Cattle rearing a large industry.

Vegetable—Wheat, maize, oats, rye, barley, flax, hemp, the vine, etc. ; tobacco.

Mineral—Plentiful. Iron, gold, silver, copper, lead, quicksilver, and nickel.

The salt mines of Wielicksa, in Galicia, are famous all over the world.

Prepare by means of a sketch map, in which must be inserted all names to be remembered.

Industries.—Agriculture, mining, glass-making, cattle, sheep, and pig rearing, paper making.

Towns.—Vienna (fancy goods, silk, cotton, jewellery), Buda-Pesth (or Ofen-Pesth, a double town on the Danube, capital of the Kingdom of Hungary), Prague, Lemberg, Gratz, Trieste, Fiume, Neusohl, Chemnitz, Tokay, Szegedin, etc.

Government.

Austria (embracing Lower Austria, Upper Austria, Salzburg, Styria, Carinthia, Carniola, The Tyrol, Bohemia, Moravia, Silesia, Galicia, and Dalmatia) has an Upper and Lower House, with the Emperor as head.

Hungary (with Transylvania, Fiume, Croatia, and Slavonia) has a Parliament of 453 members, a House of Lords, with the Emperor of Austria as King.

Turkey.

The limits to which the territory under Turkish rule in Europe have been reduced are explained below. The boundaries of Turkey at present are Montenegro and East Bulgaria on the north, the Adriatic on the west, Greece on the south, and the Ægean, Marmora, and Black Seas on the east. It also includes the islands of Crete, Thaos, Samothracea, Imbro, and Lemno, in the Ægean.

This sea is also called the Archipelago (from the Greek, *arche* = chief, *pelagos* = a sea), because to the old Grecian Empire it *was* the chief sea. Note that in its original meaning it had nothing to do with islands, although now applied to any sea containing numerous islands.

Mountains.—The chief ranges are the Balkans, Little Balkans, Despoto Dagh or Rhodope Mountains, and the Tekeir Dagh, and the Pindus range.

Rivers are unimportant, the Maritza being the chief.

Productions :—

(*a*) Mineral—There is abundance of coal, and also copper, iron, lead, silver, and salt ; but they are not worked.

(*b*) Animal—Jackal, wolf, bear, and boar, and the ordinary domestic animals. The silkworm is also largely reared for silk.

(*c*) Vegetable—The soil is extremely fertile ; but, under Turkish misrule, there is little inducement to cultivate it to its fullest extent. Maize, wheat, millet, rice, tobacco, cotton, flax, hemp, olives, vine, poppy (for opium), tobacco, roses (for otto of roses), etc., are cultivated.

Industries.—Mainly stagnant. Agriculture the chief ; some little mining, rearing of silkworm, fishing, cattle rearing, carpet weaving, tobacco manufactures, etc.

Towns.—Constantinople (or, as the Turks call it, Stamboul), the seat of government, the former capital of the Eastern Empire, occupies a magnificent situation on the Bosphorus. Scutari, Adrianople (named after the Emperor Hadrian), Gallipoli, Salonika, and Janina.

The *Religion* is Mohammedanism ; education neglected.

The *Government* is an absolute monarchy, and is the worst in Europe.

So unstable is the Turkish rule that it is known to the rest of Europe as 'The Sick Man.' 'The Sublime Porte' is another term applied to the government.

Greece.

Area, 25,000 square miles.

Coast Line.—Very broken. Gulfs of Volo, Egina, Nauplia, Laconia and Messina, Arcadia, Patras, Lepanto or Corinth, and Arta.

Capes—Gallo, Matapan, Malia, Colonna.

Islands.—Corfu, Cephalonia, Zante, Cerigo, Milo, Santorin, Naxos, Paro, Andro, Negropont or Eubœa, etc.

Mountains. — Pindus, Orthys, Pelion, Ossa, Parnassus, Helicon, Taygebus.

Productions.

Animal—Lynx, wolf, bear, fox, jackal, ass, goat, and sheep.

Vegetable—Olive, grape, fig, date, lemon, orange, mulberry, and tobacco. The Ionian Islands are famous for currants.

Mineral—Marble, lead, and silver in Attica; coal and iron in Negropont ; salt and sulphur.

Climate.—Mild and enjoyable.

Towns :—

Athens, the former capital of the Grecian Empire. Famous for artistic remains. The citadel, or Acropolis, contains the ruins of the Parthenon, or Temple of Minerva, one of the wonders of the world. Its port is Piræus.

Missolonghi, on gulf of Corinth, where Byron died.

Corinth, a shadow of its former greatness.

Patras, a principal port.

Navarino, where the Turkish fleet was destroyed in 1827.

Nauplia, the Gibraltar of Greece.

The places renowned in the times of Grecian splendour, such as Thebes, Argos, Sparta, etc., are now mere villages.

Government and People.—Greece was, together with the rest of the Balkan Peninsula, captured by the Turks, and the demoralising effects of long Turkish rule have scarcely died out. The country regained independence in 1830, and was constituted a limited monarchy, and Thessaly and a part of Epirus was added to it in 1878. The religion is mostly Greek Church. Every endeavour is being made to educate the people up to the reputation of their forefathers, and possibly in the near future their territory may be still further enlarged at the expense of Turkey.

The numerous islands require attention. They are nearly all of importance, on account of their historical associations.

Draw a map, insert all names, and learn thoroughly.

The Balkan States.—Bulgaria, Eastern Roumelia, Roumania, Servia, and Montenegro.

Particular care must be taken, in studying this section of Europe, to thoroughly understand the relation of these States to Turkey. At the beginning of the present century, the whole of the Balkan Peninsula, from the Black Sea to the Adriatic, from the Danube and Pruth to Matapan, was under the rule of Turkey. The Turks being notorious for oppression and misrule, it is little wonder that in many parts the native population should have attempted and succeeded in throwing off the Moslem rule.

In 1830 Greece established its independence ; Roumania declared its independence in 1858, and by the Berlin Treaty (1878)—an arrangement between all the Powers of Europe—much territory was detached from the Turkish Empire, and probably the Turk would have been expelled from Europe altogether but for the difficulty arising as to who should take Constantinople.

By that treaty Thessaly was given to Greece, Servia and Montenegro were made separate kingdoms, the autonomy of Roumania was recognised, Bulgaria and Roumelia had home rule granted, Bosnia and Herzegovina were placed under Austrian rule, and Cyprus was taken by England.

Bulgaria and E. Roumelia (since 1886 subject to one government).

Chief Towns—Sophia, Shumla, Varna, Plevna, Widen, Sistova, Rustchuk, and Silistria.

Roumania (made a kingdom in 1881).

Chief Towns—Bucharest, Jassy, Galatz.

Servia—Government: King, Senate, and National Assembly.

Chief Town—Belgrade.

Montenegro—Capital: Cettinje.

All these States are mainly engaged in agriculture—wheat, maize, the vine, tobacco, etc., being largely produced. The industries, etc., peculiar to each State must be prepared from the text book. Maps should be drawn of each State.

F.—*History.*

Edward VI. and Mary I.

Edward VI.

Chief points :—

(*a*) The mode of government—Somerset Protector, afterwards Northumberland.

(*b*) The war with Scotland, and the disastrous defeat of the Scots at Purkie.

(*c*) The progress of the Reformation.

(*d*) Ket's rebellion, and other insurrections.

(*e*) Fall of Somerset, and death of the King.

The chief points on which progress was made in the Reformed Religion were :—

All Statutes concerning the punishment of heretics and Lollards, including the Statute of Six Articles, were repealed.

Sacrament was to be administered in both kinds.

Two Acts of Uniformity were passed, enforcing the use of the new Service Book.

1549. Edward's First Prayer Book was issued, but being considered too Romanist, a revised edition was published in 1552.

A Book of Homilies and the Forty-Two Articles were issued.

A copy of the Bible was ordered to be placed in every church.

With the money obtained from the dissolution of monasteries, etc., many schools were founded; 'King Edward School' being found at the present time in many towns.

Mary I.—1553–1558.

Chief points:—

(1) The short reign of Lady Jane Grey—acting under advice of Northumberland, and the circumstances leading to Mary's accession.

(2) The re-introduction of Roman Catholicism, and the consequent Marian persecution.

(3) Marriage with Philip, against national desire—Wyatt's rebellion.

(4) The war with France to aid the schemes of Philip, and loss of Calais, the only remaining Continental possession.

Lives of Northumberland, Lady Jane Grey, Cranmer, etc., should be prepared.

G.—*Euclid.*

Second Year.—Book I., Propositions 17–20, and two deductions per week.

Third Year.—Book I., Propositions 42–44, and two deductions per week.

H.—*Algebra.*

Third Year.—Thomson's 'Scholarship Algebra.' Read carefully Chapters XIV. and XV., and work the examples thereon.

I.—*Teaching.*

Second Year.—The teaching of Dictation, Transcription, and Composition—the best methods and the uses of the various subjects ('Scholarship School Management').

Third Year.—'Discipline' (Chapter X. pp. 97–105, 'Scholarship School Management').

(This section is very important, as it underlies the whole of school work, and upon it depends, to a very large extent, the success or otherwise of the ordinary lessons.)

TEST QUESTIONS.

1. *Penmanship.*—Write as specimens of—

(*a*) Large-hand:—Metamorphosed, Nylephtha, Oxymandias, Parallelogram.

(*b*) Small-hand:—

'Lives of great men all remind us,
We can make our lives sublime.'

(This subject is universally weak, and requires steady and continual attention, with practice each day from a good model.)

2. Write an essay each week, selecting from the following topics:—

(*a*) Influences which form character; (*b*) Photographs; (*c*) Heroism; (*d*) Punctuality; (*e*) Trial by Jury; (*f*) 'Hope springs eternal in the human breast'; (*g*) 'Uneasy lies the head that wears a crown.'

(Make an analysis, or skeleton outline, on which to work, copy into a note-book, and preserve for future reference.)

3. *Notes of Lessons.*

First year pupil teachers should write outline notes; second and third year pupil teachers full notes:—

(1) Monkeys; (2) A grocer's shop; (3) Moths and grubs; (4) Short Division; (5) Relative Pronoun; (6) Warwick, the Kingmaker; (7) Water; (8) Latitude and Longitude; (9) Postage Stamps.

A criticism lesson must be given each week, and a special book must be kept in which criticisms, etc., are entered.

(N.B.—In Arithmetic and Grammar lessons the teaching must be inductive, the new rule, definition, or fact being obtained from reasoning from suitable examples. In all lessons the greatest care must be taken to follow a logical and natural *method*. Teach only those facts which are useful.)

4. *First Year.*

(*a*) Distinguish between Strong and Weak Verbs. To which class would you refer:—*keep, step, cut, must, shut.*

(*b*) Give the meanings and use of the suffix *en*. What is the meaning of the suffix in spinster, youngster; worship, friendship; wayward, leeward?

(*c*) Analyse the following passages, and parse the words in italics:—

(i.) I think *that* we
Shall *never more*, at *any* future time,
Delight our souls with *talk* of knightly deeds.

(ii.) *But* oars alone *can ne'er prevail*
To reach the distant coast;
The breath of heaven *must swell* the sail,
Or all the toil *is lost.*

(iii.) Roll on, *thou* dark and deep blue *ocean*, roll!
Ten thousand fleets sweep over *thee in vain:*
Man marks the earth with ruin—his *control*
Stops with the shore.

(iv.) The applause of *listening* senates *to command,*
The *threats* of pain and ruin to despise,
To *scatter* plenty o'er a smiling land,
And read *their* history in a *nation's* eyes—
Their lot *forbade.*

Music.—(i.) Between what tones of the scale is there an interval of a major second?

(ii.) Write the pulse signs for three-pulse and four-pulse measure.

(iii.) Write a nine-pulse note in four-pulse measure.

Second Year.

(*a*) Adjectives are said to be used in three ways. Which of these is not applicable to pronouns?

(*b*) What difference in meaning is there between *later* and *latter; older* and *elder.* Comment on *rather, inferior, better.*

(*c*) Give the meaning of the prefix in the following words:—*Subsist, redolent, preterite, triangle, unicorn, pardon.*

(*d*) Paraphrase and analyse the following, and parse the words in italics:—

(i.) A time *there* was, ere England's grief began,
When every rood of ground maintained its man.
For him light labour spreads her wholesome *store,*
Just gave *what* life required, *but* gave *no more.*
His *best* companions, innocence and health,
And his best riches, *ignorance* of wealth.

(ii.) And when sunset *may* breathe, from the lit sea *beneath,*
Its *ardours* of rest and of love,
And the crimson pall of eve may fall
From the depth of heaven *above,*
With wings *folded* I rest, on *mine* airy nest,
As still as a brooding *dove.*

Music.—(i.) What is the mental effect of *fah, te, ray.*

(ii.) Write signs for four-pulse and nine-pulse measures.

(iii.) Name the intervals *me-te, fah-te, te$_1$-fah.*

Third Year.

(*a*) What were the chief works of Spenser? Mention some of the dramatists of Elizabeth's reign.

(*b*) Write a life of Shakespeare.

(*c*) Paraphrase and analyse the following, and parse the words in italics:—

(i.) There were two fathers in that ghastly crew,
And with them their two sons, of whom *the one*
Was more robust and *hardy* to the view;
But he died early, and when he *was gone,*
His nearest messmate told his sire, who threw
One glance on him, and said, 'Heaven's *will be* done!
I can do *nothing,*' and he saw him *thrown*
Into the deep without a tear or grown.

(ii.) And then there was a little isle,
Which in my *very* face *did* smile,
The *only one* in view;
A small green *isle,* it seemed no more,
Scarce broader than my dungeon floor,
But in it there were three tall trees,
And o'er it flew the mountain breeze,
And by it here was water flowing,
And on it there were young flowers *growing,*
Of gentle breath and hue.

5. (*a*) By what means did Henry VII. endeavour to make his dynasty secure on the throne? What were some of the results of his marriage schemes?

(*b*) Write notes on the following :—Star Chamber, The New Learning, Morton's Fork, Field of the Cloth of Gold.

(*c*) Sketch briefly the progress of the Reformation in England.

(*d*) Give an account of the Suppression of the Monasteries.

6. (*a*) Describe a journey from Christiania to Hammerfest, with a sketch map.

(*b*) What are the industries of the people of Denmark? What do we import from that country?

(*c*) Enumerate the rivers that take their rise in Switzerland. Into what seas do they flow?

(*d*) Where and what are the following :—Maelstrom, Righi, Skapta Jokul, Sulitelina, Zermatt, and Schaffhausen.

7. *Second Year.*

(i.) What should be the minimum length of slate pencils, and why?

(ii.) What are the chief characteristics of good writing, and how may they best be attained.

Third Year.

(i.) What precautions should be taken in schools with regard to the eyesight of the children?

(ii.) What outside circumstances affect the discipline of a school?

8. *Third Year.*

Work the following :—

(1) Add together $7x(x^3-2)$ and $7x^2(2x-1)$, and divide the result by x^2+3x+2. Ans. $7x^2-7x$.

(2) Multiply $\frac{1}{2}a^3-a-\frac{1}{3}$ by $\frac{2}{3}a^2+3a-1$. Ans. $\frac{2}{3}a^4-4a^2+\frac{1}{3}$.

(3) Find the expression by which $36x-23x^2+12x^4+8$ must be divided in order that the quotient may be $3x^2+6x+1$, and the remainder $2x+1$. Ans. $4x^2-8x+7$.

(4) Find the fourth power of $\frac{30x^2}{2y^3}$, and the fifth root of $\frac{243a^{20}b^7c^{23}}{32b^2c^{28}}$. Ans. $\frac{81a^4x^8}{16y^{12}}$; $\frac{3a^4b}{2c^3}$.

SCHOLARSHIP COURSE FOR FEBRUARY.

The 1895 Scholarship Examination.

The questions set in the Examination, and which will be found in another column, were well up to the standard of preceding years, if not in some cases slightly more difficult. With a few trifling exceptions they presented no difficulty to any student who had conscientiously followed the work prescribed in last year's course. Indeed, it is a matter of gratification that all the points specially emphasised appeared in one form or another in the papers. Several of my correspondents have complained of the lack of time to finish, and this is a satisfactory sign, but it should be noted by those who have just embarked on work for next December that facility in answering questions is greatly needed, and that this is only acquired by steady and regular practice. Taking the papers in detail, the *School Management* was a very fair and comparatively easy paper. The theory questions were all well within the scope of the text-book ('Scholarship School Management'), and those who took the advice given to specially look up the Object Lessons and Suitable Occupations must have felt pleased with themselves.

The *History* was more difficult than preceding years, but a wide choice was given. Elizabeth's 'Progresses,' perhaps, were unknown to some, for they are not described in any ordinary text-book.

The *Arithmetic* was long but not difficult, the *Alternative Algebra for Women* was more difficult than was expected. Great stress seems to be laid on the proofs of the various rules. The *Dictation* was long but easy.

The *English* paper was, perhaps, the most disappointing. Not so much the *Grammar* part of it as the questions on the Literature. To give the author of the extracts given would be an impossibility to most Pupil Teachers, and the question on changes in words since Shakespeare's time is altogether beyond the usual acquirements of young teachers.

The subjects for *Composition* were very suitable, and would be easy to those who have written an essay regularly every week. The *Domestic Economy* was easy. The *Euclid* long, and well up to former Exams. The *Music* would be answered by anyone who had followed the course. The *Geography* was very searching, the questions on Physical Geography being in advance of anything previously set. The *Algebra* and *Mensuration*, too, showed some advance, and required not only a knowledge of the straightforward rules but also some acquaintance with the 'dodges' by which problems are often solved. The *French* and *Latin* were rather longer than usual, but not harder than previous papers. On the whole, the student who had honestly done his or her work would not be disappointed, but those who had attempted cram instead of intelligent study will probably find themselves some way down the list.

The New Syllabus for 1896.

There are several important changes in the syllabus for the next Scholarship examination, which intending students must carefully note.

1. A note at the head of the syllabus points out that the numbers given after the various subjects indicate the full marks, *and that this applies to Science, Art, and the University Extension Certificates.* This may be taken to mean that students will be credited with the marks ONLY which they obtain in these subjects.

2. The marks awarded to the various subjects have been revised, and now stand as follows :—

Subject.	1895.	1896.	Subject.	1895.	1896.
Reading - -	60	60	Practical Teaching	80	100
Repetition - -	40	40	Theory of Teaching	80	100
Writing - -	60	60	Needlework -	80	100
Spelling - -	50	50	Domestic Economy	60	80
Composition - -	30	60	Music - - -	50	50
English - - -	70	100	Languages (each) -	70	100
Alt. Latin - -	70	100	Science		
Arithmetic - -	70	100	Elementary Pass	30	50
Algebra and Mensuration - -	80	125	Advanced 2nd -	40	60
			,, 1st -	50	75
Euclid - - -	80	125	Drawings - -	100	100
Geography - -	70	100	University Certificate - - -	125	125
History - - -	70	100			

3. Alterations in various subjects. (Alterations in italics.)

(*a*) Geography.—Physical, political, and commercial of the British Empire.

Maps.—Some part of British Isles *or Hindustan.*

(*b*) History.—Outlines of English History *from the accession of Henry II. to the Restoration*, with a special knowledge of the *reign of Charles I.*

(*c*) Practical Teaching.—To obtain marks, lessons may be given by those who have been employed within two years preceding the Examination in Public Elementary Schools.

(*d*) Marks for Science and Drawing will only be given for *successes obtained the same year* as the Scholarship.

Marks will be allowed for a First Class *or Second Class* in Drawing.

(*e*) The 60 marks allowed last year for a University Extension Certificate are increased to 125, but the subjects are limited to English Language and Literature, Geography, History, Languages, but *a candidate who obtains marks for any such certificate may not obtain marks for the corresponding subject in this Syllabus.*

(*f*) The Authors in Languages are unaltered.

Candidates should apply for a syllabus to the 'Secretary, Education Department, Whitehall, S.W.'

Work for the Month.

1. *Reading and Penmanship.*—Ten minutes' practice each day. The reading must be oral, and should be given to some person capable of criticising and pointing out faults. Repetition of words is not enough—elocution is required.

It cannot be too often impressed upon scholarship students that their writing is an important factor in the Examination, and *always* wants care.

2. *Spelling.*—Learn 50 words per week from 'Words Commonly Misspelt' or any good list. Test frequently by dictation from a standard writer.

3. *Composition.*—Write one or two essays each week, selecting from the following :—

(1) Town and country life contrasted.
(2) The English character.
(3) The liberty of the press.
(4) Wild flowers.
(5) Is war ever justifiable?
(6) Punctuality.
(7) The employment of riches.
(8) A snow storm.
(9) Music.
(10) The reign of Queen Victoria.

Read up all you can about the subjects, arrange your ideas under certain definite heads, express your meaning clearly and concisely, copy the 'skeleton' of the essay into a note-book for future reference and use. This arrangement of ideas soon becomes a habit, and prevents any wandering and tedious repetition.

Supposing No. 5 is selected. Open your essay by admitting the terrible sufferings, etc., produced by war, and that in many cases war has been entered upon for very trivial matters. Then proceed to discuss cases in which war is not only justifiable but necessary, *e.g.* (*a*) when a country repels an invader; (*b*) when countries unite to put down a tyrant; (*c*) when a people fights for liberty of mind and body; (*d*) when the terrible practices of uncivilised nations cannot only be stopped by war. Finish by deprecating the necessity, and expressing a hope that the time will soon come when the war drum beats no longer, etc.

4. *English.*

(*a*) Learn 50 roots and meanings each week from any good list.

When any new word is met with it is advisable to look at its derivation.

(*b*) The Adjective. Chief points:—

(*a*) A good classification and definition of each term used and its derivation.

(*b*) Comparison and irregular comparison.

(*c*) The three ways in which Adjectives are used—Attributively, Predicatively, and Factitively.

(*d*) Adjectives that do not admit of comparison.

(*e*) Any points of importance on single words, *e.g.*, distinguishing the meanings of *later* and *latter*, *older* and *elder*, the double inflections in *nearer*, *former*, etc.

(*c*) Literature (Chap. II., Meiklejohn's 'Outlines of English Literature.'

Mandeville, Wyclif, Gower, Langland, Chaucer, and Barbour.

Prepare brief life of the above, with a list of their chief works, and a few notes on their style. One most important point to notice in connection with this period is the fusion of the Anglo-Saxon and Norman-French into English. Chaucer has been called 'the finder of our fair language' because he was the first to use English to any great extent, and so popularised it, an example which was followed by subsequent writers. Note also the contrast between the historians and romancers who dealt with legendary lore and the vivid pictures of home life and English manners and customs depicted by Chaucer.

The absence of much literature at this period was due to the laziness of the Church, and to the continual fighting which was going on, and which distracted men's minds from thought. The rapid and cheap production of books was yet to come.

5. *Arithmetic.*

Boys.—Interest. Make quite sure of the methods of finding Principal, Rate, Time, or Percentage when the other three are given.

Work Exs. CXVIII.–CXXIII (Lock).

Girls.—Dixon & Beach, Chaps. XXV.–XXVII. Problems on mixed agents and mixtures are very common.

Study carefully the model solutions given.

6. *Algebra.*

Boys.—'Scholarship Algebra.' Read carefully Chaps. XII.–XIV., H.C.F. and L.C.M., and work examples thereon.

These sums should always be worked by factors if possible, since it simplifies and shortens the work. The proof of the rules for H.C.F. and L.C.M. must also be mastered.

Girls.—Scholarship Algebra. Read Chaps. III. and IV., and work examples on them. Write for assistance with any difficulty.

7. *Euclid.*—Book II. Prop. 4–6 and four deductions per week.

Note also how to express the various enunciations in algebraical form, thus II. 4. If a line be divided into any two parts, the square on the whole is equal to the squares on the parts together with twice the rectangle contained by those parts. Let a = one part of the line and b = the other part. Then the whole line is $(a + b)$, and we get that

$$(a + b)^2 = a^2 + b^2 + 2ab.$$

8. *Geography.*—The best text-books for the British Empire are 'Hughes' Colonies,' or 'Meiklejohn's British Empire.' In addition to a good text-book, students should read everything they can get bearing upon our empire. Parkin's 'Round the Empire' (Cassell and Co.) is a book everyone should read.

For this month prepare thoroughly the European Possessions—Gibraltar and the Maltese Islands; Asiatic Possessions—Aden, Cyprus, Straits Settlement, Hong Kong, and other minor possessions in Asia.

Draw a map of each colony. Note carefully imports, exports, towns, people, and governments, etc.

9. *History.*—Prepare the reigns of Henry II., Richard, and John.

Chief points:—

Henry II.—Claim to the throne.
Foreign possessions.
Dispute with Church.
Legal Reforms.
Conquest of Ireland.
Rebellion of sons.

Richard.—The Crusades.
The government during Richard's absence.

John.—The war with France.
Dispute with Rome.
Home government and events leading up to Magna Charta.
Magna Charta and its provisions.
The subsequent civil war.

Learn the following note:—

Henry II.'s Legal Reforms.

1164.—*Constitutions of Clarendon.*

(*a*) No tenant *in capite* to be excommunicated save by king's leave.

(*b*) No bishop to leave the realm but by the king's permission.

(*c*) Bishops to do homage to the king for their lands.

(*d*) Clerical offenders against the civil laws to be tried or punished by civil law.

(*e*) No villein's son to be admitted to orders without the consent of his lord.

1170.—*Inquest of Sheriffs.*

The office of sheriff transferred from the feudal nobility to officers of the King's Court—a blow at the Baronial power.

1166.—*Assize of Clarendon* revived Frankpledge and established the Grand Jury.

1176.—*Assize of Northampton.*

Division of England into 6 circuits, each with 3 justices.
Oath of fealty exacted from all classes.

1181.—*Assize of Arms.*

Every freeman to bear arms according to his position—a revival of the ancient 'fyrd' or Anglo-Saxon Militia.

10. *School Management.*

'Scholarship School Management,' Chap. II., Teaching Methods, Questioning, etc.

A very important chapter, since it affects the proper teaching of all that follows.

11. *Domestic Economy.*—Food.

(*a*) Its functions.
(*b*) Classification—Nitrogenous and Carbonaceous.
(*c*) The compounds.
(1) Nitrogenous — albumen, gluten, gelaten, fibrin, myosin, casein, legumin.
(2) Carbonaceous—fats, oils, sugar, gum, starch.
In what foods they are found and their value as foods.
(*d*) The character, value of food, components, cost, digestibility of poultry, game, fish, beef and veal, mutton and lamb, pork and bacon, eggs, butter, cheese.
(*e*) Milk as a perfect food.

12. *Music.*—Two-, three-, four-, six-, and nine-pulse measures, primary and secondary. The divisions of a pulse into halves, quarters, and thirds.

13. *French.*—Prepare the first five pages of 'Le Tresor.' The grammar of the Adjective, comparison, formation of feminine and plurals. Note particularly the feminines formed irregularly.

QUESTIONS TO BE ANSWERED.

1. *Penmanship.*—Write as specimens of—

(*a*) Largehand:—Cyclostyle, Dicotyledon, Feringhee.
(*b*) Smallhand:—'Roll on, thou deep and dark blue ocean, roll!'

2. Analyse the following passages, and parse the words in italics:—

(*a*) 'Not the same *meed*
The gods mete out for all, or she, the dread
Necessity, *who* rules *both* gods and men,
Some to dishonour, some to honour, moulds,
To happiness *some*, some to unhappiness.

'But *thou*, if e'er
There come a daughter of thy love, oh, *pray*
To all thy gods, *lest haply* they *should mar*
Her life with *too* great beauty.'
'Epic of Hades.'—(Set last Scholarship.)

(*b*) It is an *isle* under Ionian skies,
Beautiful *as* a wreck of Paradise,
And, *for* the harbours are not safe and good,
This land *would have remained* a solitude
But for some pastoral people *native* there,
Who from the Elysian, clear, and golden air,
Draw the last spirit of the age of gold,
Simple and spirited, innocent and bold.—(Dec. 1894.)

(*c*) And is this *Yarrow? This* the stream
Of which my fancy cherished
So wakefully a waking dream,
An *image* that hath perished?
O! *that some* minstrel's harp were near
To utter notes of gladness,
And chase this silence from the air
That fills my souls with sadness.—(July 1894.)

(*d*) This is the state of man: to-day he puts forth
The tender leaves of hope, *to-morrow blossoms*,
And bears his blushing honours *thick* upon him,
The third *day* comes a frost, a killing frost;
And—when he thinks, good easy *man*, *full surely*
His greatness is *a-ripening*—nips his root,
And then he falls, as I do.

3. Comment on the case of the words in italics in the following:—He was elected *king*. It cost three shillings a *pound*. He slept the *sleep* that knows no waking. Whip *me* such honest knaves. Near the *lake*. I injured *myself*.

4. Give instances of nouns that have two plurals. Discriminate between the meanings of the two.

5. Write full notes of Lessons on the following subjects:—
Birds' Nests (Infants); The Suez Canal; The Armada; The Steam Hammer; A first lesson in Long Division; Cleanliness and Health; A Trial by Jury; Dew.—(N.B.—The first four were set last examination.)

6. (*Boys.*) Resolve the following into factors:—

(*a*) $4y^2z^2-(y^2+z^2-x^2)^2$.
Ans. $(x+y+z)(y+z-x)(z+x-y)(x+y-z)$.

(*b*) $x^3-17x^2y^2+60xy^4$. Ans. $(x)(x-5y^2)(x-12y^2)$.

(*c*) x^3-x^2-x+1. Ans. $(x+1)(x-1)^2$.

(*d*) $(13x^2-5y^2)^2-(12x^2+4y^2)^2$.
Ans. $(5x+y)(5x-y)(x+3y)(x-3y)$.

(*e*) $8x^2-27y^2+1+18xy$.
Ans. $(2x-3y+1)(4x^2+9y^2+1+6xy-2x+3y)$.

(*f*) x^4+9x^2+81. Ans. $(x^2+3x+9)(x^2-3x+9)$.

(*g*) $2x^3+x^2-2x-1$. Ans. $(2x+1)(x+1)(x-1)$.

7. (*Boys and Girls*).

(*a*) The population of a parish exceeds 3,000, and is less than 4,000; whether the people are arranged in groups of 8 or 9, or 15, or 18, or 25, 7 always remain over. Find the exact population. Ans. 3,607.

(*b*) Find the G.C.M. and L.C.M. of 157 days 7 hrs. 4 mins. 7 secs., and 243 days 2 hrs. 11 mins. 49 secs.
Ans. G.C.M. 14 days 7 hrs. 11 mins. 17 secs.
L.C.M. 2,674 ,, 0 ,, 9 ,, 59 ,,

(*c*) Simplify $1\frac{3}{8}$ of $\dfrac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{2\frac{1}{2}-3\frac{1}{3}+4\frac{1}{4}} \times \dfrac{2\frac{1}{2}+\frac{2}{15}}{\frac{3}{4}+\frac{1}{3}}$ of $\dfrac{1\frac{1}{3}}{4\frac{1}{2}+3}$.
Ans. $\frac{1}{4}$.

(*d*) What is meant by the reciprocal of a number? What fraction divided by its reciprocal gives a quotent $\frac{1}{2}\frac{6}{5}\frac{2}{5}$?
Ans. $\frac{2}{5}$.

(*e*) If 3 men with 4 boys earn £5 16s. in 8 days, and 2 men with 3 boys earn £4 in the same time, in what time will 6 men and 7 boys earn 20 guineas? Ans. 15 days.

(*f*) Divide 85 into two parts, so that $\frac{2}{3}$ of the one may be $\frac{3}{4}$ of the other. Ans. 45 and 40.

8. Explain the varying length of day and night. How long is the sun visible at the North Pole together?

9. Give the outline of a lesson on latitude and longitude.

10. In what way can proficiency in teaching be promoted by studying the minds of children? Why do infants calculate with concrete objects, while counting on fingers is not allowed to older children?

11. Describe the various stages of digestion, pointing out clearly in which stages the nitrogenous and carbonaceous elements in the food are digested.

12. What are the mental effects of the submediant, dominant, supertonic, leading note, and mediant of the scale?

13. Give the rules for the formation of the plural of nouns in French, and give the plurals of *travail*, *bateau*, *bal*, *aieul*, *ciel*, and *joujou*.

NOTES ON LAST MONTH'S QUESTIONS.

4. (*a*) Numbers are prime to each other when they do not contain a common factor.
(*d*) To multiply by 729,819 in 3 lines.
The number $=(9^3\times1000)+(9^2\times10)+(9)$.
∴ Multiply by 9, then multiply this result by 9, placing the result one place to the left, then multiply the second line by 9, placing the result 3 places to the left, and add.

5. The error in this lies in cancelling $(x-x)$ from each side. This is practically dividing by 0; we cannot say that 0 divided into $(x+x)=(x+x)$. The true result is infinity.

CORRESPONDENCE.

1. Individual assistance will be given as far as possible by advice, solution of difficulties in any subjects, model answers, etc.

2. Specimens of Writing, Paraphrasing, Maps, Composition, etc., will be marked and criticised gratis.

3. To assist students in rural districts, Freehand or Model Drawings will be corrected and marked, with hints for improvement, etc., and returned if accompanied by a postage stamp.

4. As a rule, all replies will appear in the Correspondence Column, but anyone desiring an immediate reply may obtain it by enclosing a stamped, addressed envelope.

5. To ensure an answer in the next issue queries must be sent by the 15th of each month.

6. Name and address of sender, with coupon of current number of the PRACTICAL TEACHER, and *nom de plume* if desired, must be enclosed.

All communications and queries with regard to these courses should be addressed 'A. F. FLUX, 12, Lower Park Road, Belvedere, Kent.'

ANSWERS TO CORRESPONDENTS.

W. B. R.—Your query is answered above.

DISAPPOINTED.—You must remember that it is the same to all. The difficulty of the questions will not affect your relative position to any extent.

R. H. BUTTERWORTH.—For next April Examination of pupil teachers. *First year*—Gray's Ode 'The Bard,' *and*, 'On a Distant Prospect of Eton College.' *Second year*—Goldsmith's 'Traveller,' *or* Cowper's 'Morning Walk.' (The latter is Book V. of *The Task*, 'A Winter Morning Walk.') Messrs. Macmillan have good editions of all.

J. L.—'*Bertrand du Guesclin*,' 2s.—'*Les Enfants d'Edouard*,' 1s.—Both published by Messrs. Hachette & Co., King William Street, Charing Cross. I do not know of any translation; I do not think there is one published in England.

ANSWERED BY POST.—T. E. P. (Birmingham); E. M. A. (Llanelly); A. B. M. (Street); H. T. (Silverdale); I. M. (Forest Hill); Miss Y. (Wisbeach).

Notes on Physiology.—In consequence of the illness of Dr. Walker Overend this contribution is unavoidably held over. We can, however, promise our readers that a double supply of NOTES will appear in our next number.

OUR 1896 CERTIFICATE CLASS.

BY J. C. HOROBIN, M.A.,
Principal, Cavendish College, Cambridge.

FIRST YEAR—MEN.

Reading, etc.

See November number.

Penmanship.

Write in text hand and small hand :—

'Negotiating is the preliminary to action.'
Democratic imperialism.

Spelling.

Write from dictation :—

The winning of honour | is but the revealing of man's virtue | and worth without disadvantage. | For some in their actions | do woo and affect honour and reputation, | which sort of men | are commonly much talked of | but inwardly little admired. | And some, | contrariwise, | darken their virtue in the show of it ; | so as they be undervalued in opinion. | If a man perform that which hath not been attempted before, | or attempted and given over, | or hath been achieved, | but not with so good circumstances, | he shall purchase more honour | than by effecting a matter of greater difficulty or virtue | wherein he is but a follower. If a man so temper his actions, | as in some one of them he doth content | every faction or combination of people, | the music will be the fuller. A man is an ill husband of his honour | that entereth into any action | the failing wherein | may disgrace him more | than the carrying of it through can honour him.

School Management.

1. How would you classify mental 'states' or activities? What bearing has this on the arrangement of a curriculum?

2. What are the objects to be kept in view in the teaching of History in schools, and what kinds of historical facts possess most interest and value in the instruction of young children?

3. Take the words *demonstrable* and *demonstrative ; fortify* and *fortitude ; residence* and *resident ; dictator* and *dictation ;* and show in each case, by reference to their structure, how the two words are related, and how you would make their exact meanings intelligible to a class, without giving formal definitions.

4. What is meant by the statement that in the growth of the intellectual powers one of them is often developed sooner than the other? Give some examples, and say what practical inferences they suggest to the teacher.

5. What do you understand by Kindergarten? How are Froebel's gifts usable in your view?

Composition.

Write a short Essay on :—

(1) The poetry of the 18th compared with that of the 19th century.
(2) Christmas.
(3) Arbitration.

Music.

1. Write descending minor scales, *Lah* mode, (*a*) once with the minor or flat seventh and the minor or essential sixth, and (*b*) once with the major seventh and the minor or essential sixth.

2. Write against each of the following intervals its name (*e.g.*, major third, etc.) :—(*a*) *ma* to *de*^{1}, (*b*) *fah* to *se*, (*c*) *ta* to *soh*^{1}, (*d*) *fe* to *ma*^{1}.

3. What is the name (*a*) for *ray* sharp, (*b*) for *te* flat, (*c*) for *soh* sharp? (*d*) State what the singer is told to do at $^{d}s_{1}$ in the following passage :—

Key C. f.F

s l r m $^{d}s_{1}$ l_{1} t_{1} r d

4. Re-write the following in the 'first flat' key (*i.e.*, regard the first note as *ray*, and so on) :—

s ta l m s f de r m ta l s f

5. Re-write the following, doubling the value of each note and rest (*i.e.*, write in two pulses what is here given in one pulse) :—

| s,l.s,f:m.,f | s.r,m :d . ‖

6. Write the pulse signs (*a*) for four-pulse measure, (*b*) six-pulse measure, (*c*) nine-pulse measure.

7. State the meanings of the following terms :—(1) *Fortissimo*, (2) *Da Capo*, (3) *Ad libitum*, (4) ♩. = M. 100.

8. Give the Italian equivalents of the following :—(1) gradually slower, (2) very fast, (3) short and detached, (4) soft.

Geography.

1. Draw maps of Australasia and India, showing the Independent States, parts under British Protection, and Foreign Possessions.

2. Describe the forms of government existing in any two of our most important Colonies and Dependencies, and explain how these governments are subordinated to the Home Government.

3. What remarkable physical features are to be found in Trinidad, New Zealand, and Canada? Give a brief description of the physical features and natural productions of either the Cape Colony or India.

4. In what parts of the world have we acquired territory during the last ten years? Give a short account of our acquisition of Burmah.

5. Which of our colonies afford good openings (1) for persons of both sexes capable of hard manual labour, (2) for families desirous of getting a grant of land and farming? Compare the conditions of life in New Zealand or Manitoba with those in the mother country.

6. Describe the sea routes to Honduras, Quebec, the Mauritius, Vancouver's Isle, Galle, and Hong Kong, giving approximately their respective distances from London, and the time the voyage would take in each case.

7. From which of our colonies do we obtain (1) the raw materials we use in Textile Fabrics, (2) Precious Minerals and Stones, (3) Articles of Food? What do we send out in return?

History.

1. Give an account of the Parliaments known as the Mad, the Good, the Wonderful, the Short.

2. What were the chief points at issue between Charles I. and the Parliament?

3. What do you know of Somers, Walpole, Pitt the younger, Wellington?

4. Mention the chief writers of Elizabeth's reign, and name one work of each.

5. Mention any Acts, and give an account of one, which directly affected the lower classes, passed during the Tudor period.

6. What do you know of Thomas Cromwell, Wolsey, Essex, Blake?

Arithmetic.

1. Simplify $\dfrac{\frac{1}{2}\{\frac{1}{2}-\frac{1}{4}\times\frac{8}{7}(\frac{1}{2}-\frac{1}{8})\}}{1+\dfrac{1}{2+\frac{1}{2}}}$.

2. Prove that $\dfrac{5+2\sqrt{3}}{4-\sqrt{3}}\times\dfrac{2-\sqrt{3}}{\sqrt{3}+1}=\dfrac{\sqrt{3-1}}{2}$.

3. Three partners in trade contribute respectively the sums of £438, £292, and £730, with the agreement that each was to receive 5 per cent. on their respective investments, and that the remainder of the gains of the firm, if any, was to be divided between them in the proportion of the sums originally advanced. The whole gain of the firm was £200. What was each man's share?

4. A reduction of 20 per cent. in the price of apples would enable a purchaser to obtain 120 more for a sovereign. What may the price be before reduction?

5. A person in London owes another in St. Petersburg 920 roubles, which must be remitted through Paris. He pays the requisite sum to his broker at a time when exchange between London and Paris is 25·15 francs for £1, and between Paris and St. Petersburg 1·2 francs for 1 rouble. The remittance is delayed until the rates are 25·35 francs for £1, and 1·15 francs for 1 rouble. What does the broker gain or lose by the outlay?

6. A and B can do a piece of work in $3\frac{3}{11}$ hours, B and C in $3\frac{3}{7}$ hours, A, B, and C in $2\frac{2}{11}$ hours. If A and B work for 2 hours, how long will A and C take in finishing it?

Algebra.

1. Find the value of :—

$$\frac{\sqrt{m+n}+\sqrt{m-n}}{\sqrt{m+n}-\sqrt{m-n}} \text{ when } n=\frac{2mp}{p^2+1}$$

2. Multiply

$$a^{\frac{1}{2}}+4a^{\frac{1}{3}}b^{\frac{1}{3}}+12a^{\frac{1}{3}}b^{\frac{2}{3}}+16a^{\frac{1}{3}}b^{\frac{1}{2}}+16b^{\frac{3}{2}} \text{ by } a^{\frac{1}{2}}-4a^{\frac{1}{3}}b^{\frac{1}{3}}+4b^{\frac{1}{2}}.$$

3. Prove that the L.C.M. of any two algebraical expressions is found by dividing one of the expressions by their greatest common measure, and multiplying the quotient by the other expression.

Find the G.C.M. of $91(x^3y - 3x^2y + 7xy - 21y)$ and $78(2x^4y^2 + 19x^3y^2 + 35y^2)$.

4. Simplify $\dfrac{\dfrac{a^2+ab+b^2}{a^3+b^3} - \dfrac{a^2-ab+b^2}{a^3-b^3}}{a^4-a^2b^2-b^4}$.

5. (*a*) Show how the square root of $a + \sqrt{b}$ may be found.

(*b*) Find the square root of $69 - 28\sqrt{5}$.

6. Solve the equations :—

(*a*) $\dfrac{8x-15}{27} - \dfrac{5 - \dfrac{2x-1}{7}}{18} - \dfrac{x-30}{12} = \dfrac{1}{36}$.

(*b*) $\dfrac{1}{3x-6} + \dfrac{7x}{72(x+2)} - \dfrac{5}{x^2-4} = 0$.

(*c*) $x - y = 3, \dfrac{1}{x} + \dfrac{1}{y} = \dfrac{11}{3}\left(\dfrac{1}{y} - \dfrac{1}{x}\right)$.

7. Find the H.M. between two given quantities.

If a, b, c, d, be in H.P., show that $ad : bc :: a + d : b + c$.

8. A picture has a margin of the same width all round, and is enclosed in a rectangular frame 4 feet 8 inches long, 2 feet 9 inches broad, internal measure. Find the length and breadth of the picture when its area is equal to the area of the margin.

Euclid.

1. Prove I. 22. Construct a triangle having given the base, one of the angles at the base, and the sum or difference of the sides.

2. Prove I. 23. Construct a triangle, being given two sides and the angle between them.

3. Prove I. 24. If two adjacent sides of a quadrilateral be equal, and the diagonal bisects the angle between them, their other sides are equal.

4. Prove II. 9. If a line AB be bisected in C and divided unequally in D, then $AD^2 + DB^2 = 2AD \cdot DB + 4CD^2$.

5. Prove III. 17. If two circles be concentric, all tangents to the inner from points on the outer are equal.

6. Prove III. 13. Find a point such that tangents from it to three given circles shall be equal.

English.

1. 'Knowledge, penetration, seriousness, sentiment, humour, Gray had them all.' Illustrate this statement from the poems.

2. 'Gray, a born poet, fell upon an age of prose.' Discuss this statement fully.

3. Comment on Avaunt, Comus, flatt'ry, empyrean, Cynthia, mitred fathers, Granta.

4. Draw up a genealogical tree to illustrate :—'A Tudor's fire a Beaufort's grace.'

5. Discuss Quick's criticism of the Tractate.

SECOND YEAR—MEN.

Reading.
Penmanship.
Composition.
Geography.
History.
} As First Year.

Teaching.

See November number.

School Management.

1. Give a specimen of the sort of black-board sketch which would be suitable for a lesson on :—

(*a*) The adverb, (*b*) a volcano, *or* (*c*) the Commonwealth, and say what use you would make of the sketch when it was written.

2. Sketch the character and career of Froebel ; and enunciate briefly the two or three main principles which he sought to enforce and to illustrate.

3. In a school containing 200 scholars and seven standards, how would you distribute the work of a single day among the several subjects of instruction, and among a staff consisting of yourself, an assistant, and two pupil teachers ?

4. What forms of recreation would you prefer, and what games would you discourage in the playground ? Give your reasons.

5. In teaching English, some teachers begin with grammatical parsing, and some with logical analysis. Which method do you prefer, and why ?

6. (*a*) What do you mean by the *closing* of a Class Register for a morning or afternoon sitting ? What acts of carelessness or irregularity on the part of the teachers and scholars should be guarded against on these occasions ?

(*b*) What facts should be recorded in the Admission Register, and in what circumstances may a name be removed from it, or be inserted in it a second time ?

(*c*) (i) What exceptions are admitted to the general regulation that in order to receive a grant a public elementary school must be open at least 400 times in the year.

(ii) Describe a scheme of Attendance Prizes.

(iii) How would you calculate the attendance for a Government Examination held at (1) an interval of seven months from the last inspection ; (2) at an interval of fifteen months ?

Music.

1. What is the name (*a*) for *doh* sharp, (*b*) for *lah* flat, (*c*) for *fah* sharp ? (*d*) Re-write the following on the 'imperfect' method (*i.e.*, without change of key) :

Doh is C. fF. C.t.

d m r fd m f t, r ml d'

2. Re-write the following in the 'first sharp' key (*i.e.*, regard the first note as *ray*, and so on) :

l fe r s fe d' t l s fe m re m

3. Re-write the following, doubling the value of each note and rest (*i.e.*, write in two pulses what is here given in one pulse) :

| s :-.s,f | m.,r :d.t, | d .r :m | r,m.f:m . ‖

4. What measures are shown by the following ?—

(*a*) | .s:l .,t | s :-.f | m,f:s | d | : — }

(*b*) :s | m,f : r : s | — :l .,t : d' | t : m }

(*c*) | m :-.f : s | l :-.s:f | m : — :r | d : — : — }

5. Note tests for Division IV. in schools consist of (*a*) a simple passage in the major key containing a transition of one remove indicated by bridge notes ; and (*b*) a short passage in the minor key or mode, introducing *se* used thus, *l se l*, but without introducing *f* or *ba*. Write two passages of not more than twenty notes each (without time) in accordance with these tests.

6. Write the time and tune of the melody of 'God save the Queen.'

7. Transcribe the following passage into two-pulse measure (*i.e.*, write in one pulse what is here in three pulses) :

| s : — : — | s : — :s | l : — :d' | s : — : — |
| : : | r' : — : — } |
| d' :m :f | s :l :s | r' : — : — | d' : — : — ‖

English.

Gray. As First Year.

Richard II.

1. Give the meaning and derivation of : inhabitable, lewd, baffled, cormorant, parasite, surfeit, adders, puny, distaff.

2. By whom and under what circumstances occur the words :—

'The ripest fruit first falls.'

3. Write a short sketch of the plot of Richard II.

4. Where and what are :—Plashy, Port le Blanc, Cicester, Barkloughly Castle, Ponfret, Langley.

Tempest.

1. Give an account of the part played by Ariel in the shipwreck.

2. Distinguish between simile and metaphor, with examples.

3. Compare Shakespeare's 'Miranda' with Homer's 'Nausicaa.'

Macbeth.

1. Give as much as you can of the speech in which occurs—
'Is this a dagger,' etc.

2. What are the principal characteristics of *Macbeth* as compared with the other great tragedies.

3. Give a summary of the banquet scene.

Geometry.

Questions 1–6. As First Year.

7. Prove IV. 7. A quadrilateral ABCD is inscribed in a circle, and AD, BC are produced to meet at E: show that the circle described about the triangle ECD will have the tangent at E parallel to AB.

8. Prove VI. 5. If two parallel lines be intersected by three concurrent transversals, the segments intercepted by the transversals on the parallels are proportional.

Algebra.

Questions 1–8. As First Year.

1. Prove $\log \frac{m}{n} = \log m - \log n$ and $\log m^n = n \log n$.

In what time would any sum of money treble itself at 5 per cent. per annum, compound interest?

$\log 3 = \cdot 477121$ (log 2 and log 7 are given previously).

2. Find the amount of an annuity left unpaid for any number of years, allowing simple interest on each sum from the time it becomes due.

A sum of £P is left to A and B, so that at the end of a and b years (when they will respectively be of age) their shares put out at compound interest at 5 per cent. per annum will be equal. Find how much is left to each.

3. The number of combinations of n things 3 together is $\frac{2}{9}$rds of the number, 5 together; find n.

4. (*a*) Show that there are $(n+1)$ terms in the expansion of $(1+x)^n$, n being a positive integer.
(*b*) Write down middle term of $(3a - 4x)^8$.

5. Solve equations:—

(*a*) $x^2 + x + 1 = \frac{42}{x^2 + x}$.

(*b*) $2x^2 + 3y^2 - xy = 31$.
$x - y = 3$.

(*c*) Prove that the sum of the roots of the equation $x^2 - px + q = 0$ is p, and their product q. If $\alpha + \beta$ be the roots of

$$\frac{h}{a-x} + \frac{k}{b-x} = 1,$$

$$h = \frac{(a-\alpha)(\beta-\alpha)}{a-b}, \; k = \frac{(a-b)(\beta-b)}{b-a}.$$

6. Find a number such that if it is divided into 8 equal parts, their continued product is equal to the continued product if the number is divided into four parts.

FIRST YEAR—WOMEN.

Reading.
Penmanship.
School Management.
Composition.
Music.
English.
History.
Geography.
} As First Year Men.

Needlework.

1. Draw a diagram of a woman's chemise ($\frac{1}{4}$ in. scale). Give directions for making up the garment.

2. Let in an irregular flannel patch, and darn on it as for a thin place.

Domestic Economy.

1. What are the component gaseous elements of water, and in what proportions are they mixed?

2. Name all necessary apparatus and appliances for (*a*) laundry work, (*b*) simple cookery, (*c*) fireplace cleaning.

3. If a family can afford meat only twice a week, what is the best and most economical food to be recommended on other days?

4. State the proportions of strength-giving, flesh-repairing, and mineral food necessary to the health of a person leading an active life. What parts of the common diet of the working classes fall respectively into each of these three classes?

Arithmetic.

1. Find the interest on £500 for 4 years at £5 7s. 6d. per cent.

2. Find the present worth of £10,500 due 15 months hence at 4 per cent. per annum, simple interest.

3. The population of 5 parishes being 1236, 452, 364, 516, 3,430 respectively; find what the population of a sixth parish must be that the average population of the sixth be 1256·5.

4. If a parcel of goods bought for £18 be sold 4 months afterwards for £25, what is the gain per cent. per annum?

5. What amount of 7 per cent. stock at 106¼ will £585 15s. purchase, and what will be the interest upon it?

6. After a rent has been reduced ⅓, a poor rate on it at 8½d. in the £1 amounts to £34; express the rate as a decimal of the original rent.

SECOND YEAR—WOMEN.

Reading.
Penmanship.
School Management.
Teaching.
Composition.
Music.
English.
History.
Geography.
} As Second Year Men.

Needlework.

1. Cut out and tack together half the front and half the back of a shirt for a child of five years old.

2. Make the lower part of a nightshirt sleeve, the wristband to be closed and stitched, and show the following stitches: sew and fell, gathering, stroking and setting-in, and stitching.

Domestic Economy.

1. What are the advantages or disadvantages of clothing clubs, shoe clubs, or other similar contrivances for saving in a school, and how do they compare in usefulness with the ordinary Post Office Savings Bank?

2. Give a list of all articles needed in order to keep a dwelling-house clean, and state the prices of each of them.

3. What are tests by which you would judge of the goodness of eggs, of bacon, of fish? Say what are the special advantages, if any, of occasional fish diet; and what kinds of fish are most wholesome and economical.

4. What are 'Consols,' and what interest is paid upon them? What is the lowest sum which may be invested in this way, and what are the advantages of this form of investment?

5. 'Those that with haste will make a mighty fire,
Begin it with weak straws.'

Is this the best way to make a fire? Give some rules suited for a class of elder girls as to making a fire, and also as to the best way of economising fuel in those times of the day when the fire is least needed.

6. What is meant by 'Stock' for cooking purposes? Say how you would use and economise it; and give recipes for two cheap and nourishing soups.

Arithmetic.

1. No. 1. Men.

2. No. 2. Men.

3. The inner wheels of a locomotive are 2½ metres asunder, and the inner wheel describes the circumference of a circle whose radius is 120 metres. Find the difference of the lengths of the paths of the wheels, having it given that the circumference of a circle equals 3·1416 its diameter.

4. Find the value of $\frac{4}{\sqrt{17} - 3}$ correct to four decimal places.

5. No. 4. Men.

6. No. 5. Men.

NOTES ON JANUARY QUESTIONS.

Arithmetic.

MEN.

1. Straightforward. Ans. $5\frac{5}{8}$.

2. Mother's age is $\frac{356}{420} \times 35$ yrs. or $29\frac{5}{12}$ yrs.

Eldest child's ,, $\frac{39}{420} \times 35$ yrs. or $3\frac{3}{12}$ yrs.

Youngest ,, ,, $\frac{25}{420} \times 35$ yrs. or $2\frac{1}{12}$ yrs.

Difference between mother and eldest child is
$29\frac{5}{12} - 3\frac{3}{12}$ or $26\frac{2}{12}$ yrs.

At end of voyage the difference of age is represented by
$(728 - 94)$ units.

But this difference is constant, viz., $26\frac{2}{12}$ yrs.

∴ Mother's age at end of voyage is

$$26\frac{2}{12} \times \frac{728}{634}, \text{ or } 30\frac{4}{12} \text{ yrs.}$$

∴ Length of voyage is 8 months.

Youngest : Mother :: $2\frac{3}{12} + 8\frac{1}{12} : 30\frac{4}{12}$.

3. Selling price of horse and cow is £88,

∴ original cost is $\frac{100 \times 88}{110}$ or £80.

Selling price at loss is $\frac{90 \times 80}{100}$ or £72 ;

∴ Original cost of cow is £72 − £63 or £9,

,, ,, horse is £80 − £9 = £71.

4. Amount of £100 in 15*m* is $100 + \frac{5}{4} \times 5$.

$$106\tfrac{1}{4} : 6\tfrac{1}{4}$$
$$x : 6\tfrac{1}{8}$$

∴ x is £105 8s.

5. Interest on 93 is £3.

,, 100 is $\frac{3 \times 100}{93}$ or $3\frac{7}{31}\%$.

Algebra.

1. Bookwork.

2. Divide and equate remainder to zero.

$$10 - 2b + 4a - 8 = 0, \text{ or}$$
$$b = 2a + 1.$$

Better way is by the F(x) theorem, viz.,

If $x + 2$ is a factor, then if (-2) be substituted in the expression for x, the resulting expression is zero, or

$$-8 + 4a - 2b + 10 = 0,$$
$$\text{or } b = 2a + 1.$$

3. Factorise, giving

$(x-1)(x-2)$; $(x-2)(x-3)$; $(x-3)(x-4)$

∴ L.C.M. is $(x-1)(x-2)(x-3)(x-4)$.

4. Bookwork.

5. By detached coefficients

(*a*)

1	1 − 8 + 24 − 34 + 24 − 8 + 1
1	
2 − 4	− 8 + 24
	− 8 + 16
2 − 8 + 4	8 − 34 + 24
	8 − 32 + 16
2 − 8 + 8 − 1	− 2 + 8 − 8 + 1
	− 2 + 8 − 8 + 1

Sq. root is $x^3 - 4x^2 + 4x - 1$.

(*b*)

1	1 + 2 + 5 + 4 + *a*
1	
2 + 5	
2 + 1	
4 + 4 + *a*	
4 + 4 + 4	

∴ a must be 4.

6. (*a*) $x = 1$.

(*b*) Multiply out and arrange, giving

$$5x^2 - 72x + 144 = 0$$
$$\text{or } (5x - 12)(x - 12) = 0.$$
$$\therefore x = 12 \text{ or } \tfrac{12}{5}.$$

(*c*) Multiply both equations by $12y$, then $6xy + 24 = 15y$ (1)

$$4xy + 36 = 20y,$$
$$\text{or } 6xy + 54 = 30y \quad (2)$$

From (2) and (1) $30 = 15y$,

$$\text{or } 2 = y$$
$$\text{and } \tfrac{1}{2} = x.$$

7. $\frac{2ab}{a+b}$, b, $\frac{2bc}{b+c}$ are in H.P. if their reciprocals are in A.P.,

$$\text{or if } \frac{1}{b} = \frac{1}{2}\left(\frac{a+b}{2ab} + \frac{b+c}{2bc}\right), \text{ or if } \frac{2}{b} = \frac{1}{a} + \frac{1}{b},$$

which is true if a, b, c, are in A.P.

8. Let x be number of sovereigns.

y ,, ,, shillings.

Then $2 \times 20x + y = 21 \times 20$

and $20x + 2y = 12 \times 20$.

$\therefore x = 10$.

$y = 20$.

SECOND YEAR—ALGEBRA.

1–8. As First Year.

1. Log 5 = log 10 − log 2 = 1 − log 2.

Log ·016 = 4 log 2 − 3 log 10.

Log $1\frac{2}{5}$ = log $\frac{2^4}{10}$ or 4 log 2 − log 10.

Log $15\frac{5}{8}$ = 3 log 10 − 6 log 2.

2. Bookwork.

3. There are three places to be filled, for the first there are 12 choices, for the second three, for the third 11 choices, therefore the number of words is $12 \times 3 \times 11$ or 396.

4. (*a*) $(4x)^7 + 7(4x)^6(5y) + \frac{7 \times 6}{1 \cdot 2}(4x)^5(5y)^2 + \text{etc.}$

(*b*) $\frac{10.9.8.7.6}{1.2.3.4.5} a^5 b^5$.

(*c*) $\frac{(-\frac{1}{2})(-\frac{1}{2}-1)(-\frac{1}{2}-2)(-\frac{1}{2}-3)}{1.2.3.4} x^4$.

5. (*a*) Equation gives at once—

$$(x^2 - 2)^2 = (\sqrt{x^2 - 2} + 1)^2$$
$$\text{or } (x^2 - 2) - \sqrt{x^2 - 2} - 1 = 0$$
$$\text{or } \sqrt{x^2 - 2} - \tfrac{1}{2} = \pm \sqrt{\tfrac{5}{2}}$$
$$x = \pm\sqrt{5} \pm \sqrt{5}.$$

(*b*) The right hand members of first equation should have been printed $a^3 + 3ab^2$.

Then $x^3 + y^3 = \frac{a^3 \times 3ab^2}{4}$

$$(x+y)^3 = a^3.$$
$$\therefore 3xy(x+y) = \frac{3a(a^2 - b^2)}{4}$$
$$\text{or } 4xy = a^2 - b^2.$$
$$\therefore (x+y)^2 = a^2$$
$$(x-y)^2 = b^2,$$
$$\text{or } x = \frac{a+b}{2},$$
$$y = \frac{a-b}{2}.$$

(*c*) Equation is given by—

$$\{x - (mu + nv)\}\{x - (mv + nu)\} = 0,$$

and it is given that $u + v = -1$

$$uv = 1;$$

∴ equation is $x^2 + (m+n)x + (m+n)^2 = 0$.

6. Let x = first outlay,

y = ,, produce,

z = ,, price ;

then

mx = second outlay,

$(m+f)y$ = ,, produce,

$\frac{100 - f}{100} z$ = ,, price,

if f be put for fall per cent.

$\frac{x}{y}$ is first cost per article, $\frac{mx}{(m+f)y}$ is second cost per article.

$z-\frac{x}{y}$ is first profit, $\frac{100-f}{100}z-\frac{mx}{(m+p)y}$ is second profit.

Total first profit is $\left(z-\frac{x}{y}\right)y$

,, second profit is $\left\{\frac{100-f}{100}z-\frac{mx}{(m+p)y}\right\}(m+p)y$,

and both are $\frac{xv}{100}$.

Equating to this, $f=\frac{100\,(100p+mv+pv-100v)}{(m+p)\,(100+v)}$.

FIRST YEAR—WOMEN.

Arithmetic.

1. In 1 hour minute hand moves over 60 minute spaces, and the hour hand through 5 minute spaces, or minute hand gains 55 minutes per hour, or 60 minute spaces in $\frac{60}{55}$ hour.

∴ at 1 h. $5\frac{5}{11}$ m. p.m. both hands are together.

2. £1,492 13s. $7\frac{7}{20}$d.

3. $5\frac{3}{80}$.

4. 134999·99755.

5. 18 days.

6. £25 15s. $5\frac{19}{22}$d.
£57 19s. $9\frac{21}{22}$d.
£77 6s. $5\frac{7}{25}$d.

SECOND YEAR.

2. Area of floor is (24×18) sq. ft.

,, centre is $\{(24-6)\,(18-6)\}$ sq. ft.

,, margin is $(432-216)$ sq. ft.

No. of yds. carpet required is $\frac{216}{9}\div\frac{2}{3}$.

Cost at 4s. 3d. per yd. is $\left(4\frac{1}{4}\times\frac{216}{9}\div\frac{2}{3}\right)$s. (x).

Cost of painting margin is £8 11s. $-x$, viz., 18s.

∴ Cost per sq. ft. is $\frac{18}{216}$s., or 1d.

NOTES AND NOTIONS.

BY RICHARD WADDINGTON,

Vice-Chairman of the Education Committee of the N.U.T.

I HAVE just returned from the Congress of the Educational Institute of Scotland, where, along with Mr. Thomas, I have been representing the N.U.T. The Lord Provost and the authorities of Perth came forth to do honour to the Teachers' Union. In no town in England of the size of Perth could such a Congress be held with such success. Feasted and fêted by the civil and educational authorities, fully reported by the leading Scotch papers, and attended by a goodly array of prominent citizens, the Congress was remarkably successful. Perth was proud of the Institute.

* * * * *

THE Educational Institute Congress differs very materially from our N.U.T. Conference. At Easter the teachers of England meet to discuss the hard facts of school life. So numerous have been the complaints in the past that disappointment has been the lot of many ardent reformers. Not so in Scotland. There, the members of the Institute stand by to hear impossible theories expounded and Utopian reforms demanded. It is the gala of the members of the School Board. The Congress is a series of papers on educational topics that hardly receive sufficient dissection at the hands of the members of the Institute. In England, the educational faddist is kept at arm's length by the teachers; but in Scotland, he is offered the platform of the Institute wherefrom to air his ideas on schools and teachers. The ideas are dealt with by the members of the Institute with remarkable timidity. The Congress is hampered by excessive dignity. Nobody really "goes for" the problem. The Class Teachers approach the Congress with bated breath and make their suggestions with a timidity that hardly reminds you of Derby Conferences. The New Year's Congress of the Educational Institute is a splendid tribute to the Scotch veneration of matters educational. No matter how long or how impossible the plan unfolded by the speaker, the Congress was steadily in earnest. No president's bell required. Everybody was attention. One feels that perhaps the ideal Conference lies somewhere between the English and Scotch meetings.

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THERE was one paper that deserved a wide circulation. Mr. Parker, the late M.P. for Perth, dealt with Superannuation in a complete and masterly fashion. Even Sir Richard Temple would have felt that here was a foeman worthy of his steel, if he had heard the ex-M.P. dilate on the details of the Select Committee's Report, the Departmental Committee, and the absolutely irreducible minimum that would suffice as a beginning. Seldom have I listened with greater interest to the voicing of the just claims of the teachers of Great Britain by a layman. The teachers of Scotland ought to have worked might and main to secure the return of Mr. Parker at the last election. I don't know to what party in politics he belongs, and I don't care. His presence during the next Session of Parliament would have been invaluable.

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MY visit to Scotland was a really enjoyable one, despite the atmospheric surrounding. With true Northern hospitality the atmosphere of Perth assumed a thickness and haziness that could almost be felt. In fact, one felt back again in Fleet Street. True, it was more difficult to imitate the climate of Bolton. To transplant the grimy smoke and tall chimneys of Bolton was beyond even the 'Fair City of Perth.' To Scotland I would go so long as Scotland remains so full of kindly hospitality and genial good fellowship.

* * * * *

THE question of the hour in the educational world is still the question of the Voluntary Schools. The feeling grows, day by day, that something more than a mere grant of five or ten shillings is required to solve the problem with any hope of finality. As I have said before, the mere addition of five or ten shillings to the Imperial Grant for all schools but puts off the evil day a few short years. And yet the present serious aspect of our foreign relations makes it doubtful whether the Government will settle down to useful domestic legislation next session. The more one studies the question from within the more

I am convinced that we want an entire reconstruction of our system of management, control, and maintenance. Take the case of a Board and Voluntary School working side by side in Bolton :—

	Board School.	Voluntary School.
Average attendance - -	632	560
Total amount spent on salaries	£1,126	£718

That is, for doing the same work, under more difficult conditions, the Voluntary Teachers receive £400 a year less. How will a five shillings' grant rectify this? If confined to the Voluntary School it would only account for £140 of the deficiency. But take the whole of the schools in Bolton :—

	Board Schools.	Voluntary Schools.
Average attendance - -	8,152	8,854
Voluntary contributions -	—	£3,756 11 1
Rates - - - -	£6,616 10 0	—
Salaries - - - -	£14,972 17 9	£12,517 8 5
Rent, rates, fuel, lighting, cleaning, and repairs	£4,119 13 6	£4,198 13 2

* * * * *

THE Voluntary Teachers of Bolton educate 702 more scholars and receive £2,455 9*s.* 4*d.* less in salaries, while for cleaning, lighting, etc., the Voluntary Schools cost £78 19*s.* 8*d.* more than the Board Schools. Turn and twist the figures as you will, there is only one sufferer by this, and that is the teacher—and too often it is the Assistant Teacher.

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CANNOT something be done in the way of a permanent settlement? Whatever be the equity of rate-aid its practibility has not yet been demonstrated, and as a matter of policy it would be bad for teachers. Take the case of Bolton again. The rate is elevenpence for educating half the scholars. To do the whole the rate would not be less than eighteenpence.

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WOULD the ratepayers assent to a levy of eighteenpence at once? I am certain they would not. What would happen would be the return of an economical School Board, pledged to do the whole for a shilling. Thus the Voluntary Schools would gain little and the Board Schools lose much. And it must not be forgotten that the reduction of the equipment of the Board Schools would destroy competition and tend to bring down Voluntary Schools. This is a battle in which all teachers must stand shoulder to shoulder. If we divide into Board and Voluntary we shall repeat the folly of 1870.

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SURELY there is some way out of the difficulty. Why not create Educational Authorities covering areas, similar to the County Councils, to administer all education, Board and Voluntary, within their areas? The present managers and the present School Boards might continue for purposes of local administration. Each Educational Authority might draw on the Exchequer for its requirements. Two difficulties only stand in the way—the appointment and dismissal of the teacher, and the country parish with only one school. The appointment of the teacher is the crux of the religious difficulty. Is it impossible to solve? The London School Board gives the local managers considerable latitude in the selection of the teachers. Suppose the local managers send up twelve names to the Educational Council, and the Council selects three from the twelve, these three to go back to the local managers for the final selection, which final selection is to be confirmed by the Council. This gives the managers all they can reasonably expect. Concerning the dismissal there is not the same demands made by the managers. The dismissal might be in the hands of the Council with a right of appeal secured to the teacher.

* * * * *

THE religious difficulty in the country parish where there is only one school ought to be capable of solution. Among all Christians there is much common ground. Take the Church Catechism. The Commandments, the Duties, the Lord's Prayer, the Creed, and the Desire are taught at present in Board Schools, and where the managers are not prepared to confine the religious instruction to these, the locality should have a second school. There would not be many places requiring the second school, for I believe the large body of the clergy would honourably stand by any such compromise.

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THE advantages of such a solution need no demonstration. The cost of education would be removed from the locality to the State, to the advantage of education. The worst features of the dual system would disappear, and the progress of education would not be interfered with by continual religious strife. The existence of the dual system would no longer mean the starvation of the Voluntary Schools, and the eccentricities of the small School Board would be less harmful.

* * * * *

WHAT a relief it is to be without the Annual Examination! I am just filling up the returns for the Department. The returns consist of Form IX. only —no schedules—with all the individual attendances. And how much calmer is the atmosphere of the school during the month before the examination. An epidemic of measles does not destroy one's rest, nor does the failure of the Fourth Standard to rise to 'three sums right out of four, one of which must be the problem,' send the teacher home distracted. No suspension of one subject to grind at another to save the grant. I know that for a time there will be misgivings as to the reform, but I feel sure that if we can get all schools under the new conditions there will be little desire to hark back.

* * * * *

THE other day I was drawing up a new Time Table for my school, and I found that, confining my-

self to a by no means too ambitious programme, I had to find time for such an array of subjects that might well make teachers and the Department pause.

* * * * *

TAKING the first three Standards I found—

Time at disposal - - - -			27½ hours per week
Religious Instruction	4	hrs.	
Recreation - -	1¾	,,	
Sewing or Drawing -	2½	,,	
Physical Drill - -	¾	,,	
Singing - - -	1	,,	
Registration - -	¾	,, = 10½	,, ,,
		17	,, ,,

In these 17 hours I had to provide for—

1. Recitation.
2. Reading.
3. English.
4. Geography.
5. Map Transcription.
6. Arithmetic.
7. Mental Arithmetic.
8. Word-building.
9. Composition.
10. Handwriting.
11. Object Lessons.
12. Suitable Occupations.

For the 17 hours I had twelve subjects; or, 1½ hours per week for each subject; or, 18 minutes a day for each subject.

* * * * *

SUPPOSING there was perfect regularity of attendance, and no continual harking back because half the class is always absent on Monday, the work could not be properly accomplished. Where is the chance of the teacher to introduce a little light and shade into the school-life? Is this the fare for little children of seven, eight, and nine years of age? Certainly not.

* * * * *

No allowance seems to be made for the growth of the requirements in subjects like Drawing and Scripture. Gradually the Drawing requirements have increased in the first three Standards. The addition of Object Lessons even where taken *in lieu* of another Class Subject means increased work. What comparison can there be between the requirements in English in the First Standard, and thirty Object Lessons? The school life of our Primary School scholar is brief in the extreme. Too many never enter their names on the register until they are seven or eight years of age, and manage with the assistance of the Local Bye-Laws to leave at eleven, if not before. To fritter away these few short years in paper-cutting is ridiculous if not worse. Let us hope that Sir John Gorst will solve the problem by making Suitable Occupations an optional Class Subject.

* * * * *

THE other day a teacher was describing how he taught spelling to a meeting of teachers. After a very exhaustive review of modern methods a teacher rose in the body, and said:—'I don't agree with all this nonsense about word-building and transcription. The teacher of the school next to mine follows that course, and when his scholars take home their papers they are marred by much blue pencil. In my school I just give out the piece thus:—"The boy stood on the burning deck; t-h-e b-o-y s-t-oo-d. When I go round to mark them there is seldom a single error, and when my scholars take home their papers the parents are well satisfied. My school is full, and my neighbour's is gradually emptying."'

* * * * *

THE resolutions for the Brighton Conference are as numerous as at any previous Easter gathering. There is a goodly array of old friends still awaiting redemption. The Rural Problem finds many champions. All sorts of solutions are projected. The one that is most needed is not very much in evidence. All the relief that can be given will be as nothing compared with the relief that would come from an increased staff. A larger and stronger crew is what the Rural Schools require, and that is just the one redress that is approached with the greatest caution. As soon as you touch the question of staff you hear of the dual system and financial difficulties. But all the other ills would very largely disappear if the State provided the schools with sufficient teaching power.

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I am convinced that we want an entire reconstruction of our system of management, control, and maintenance. Take the case of a Board and Voluntary School working side by side in Bolton :—

	Board School.	Voluntary School.
Average attendance - -	632	560
Total amount spent on salaries	£1,126	£718

That is, for doing the same work, under more difficult conditions, the Voluntary Teachers receive £400 a year less. How will a five shillings' grant rectify this? If confined to the Voluntary School it would only account for £140 of the deficiency. But take the whole of the schools in Bolton :—

	Board Schools.	Voluntary Schools.
Average attendance - -	8,152	8,854
Voluntary contributions -	—	£3,756 11 1
Rates - - - -	£6,616 10 0	—
Salaries - - - -	£14,972 17 9	£12,517 8 5
Rent, rates, fuel, lighting, cleaning, and repairs-	£4,119 13 6	£4,198 13 2

* * * * *

THE Voluntary Teachers of Bolton educate 702 more scholars and receive £2,455 9*s.* 4*d.* less in salaries, while for cleaning, lighting, etc., the Voluntary Schools cost £78 19*s.* 8*d.* more than the Board Schools. Turn and twist the figures as you will, there is only one sufferer by this, and that is the teacher—and too often it is the Assistant Teacher.

* * * * *

CANNOT something be done in the way of a permanent settlement? Whatever be the equity of rate-aid its practibility has not yet been demonstrated, and as a matter of policy it would be bad for teachers. Take the case of Bolton again. The rate is elevenpence for educating half the scholars. To do the whole the rate would not be less than eighteenpence.

* * * * *

WOULD the ratepayers assent to a levy of eighteenpence at once? I am certain they would not. What would happen would be the return of an economical School Board, pledged to do the whole for a shilling. Thus the Voluntary Schools would gain little and the Board Schools lose much. And it must not be forgotten that the reduction of the equipment of the Board Schools would destroy competition and tend to bring down Voluntary Schools. This is a battle in which all teachers must stand shoulder to shoulder. If we divide into Board and Voluntary we shall repeat the folly of 1870.

* * * * *

SURELY there is some way out of the difficulty. Why not create Educational Authorities covering areas, similar to the County Councils, to administer all education, Board and Voluntary, within their areas? The present managers and the present School Boards might continue for purposes of local administration. Each Educational Authority might draw on the Exchequer for its requirements. Two difficulties only stand in the way—the appointment and dismissal of the teacher, and the country parish with only one school. The appointment of the teacher is the crux of the religious difficulty. Is it impossible to solve? The London School Board gives the local managers considerable latitude in the selection of the teachers. Suppose the local managers send up twelve names to the Educational Council, and the Council selects three from the twelve, these three to go back to the local managers for the final selection, which final selection is to be confirmed by the Council. This gives the managers all they can reasonably expect. Concerning the dismissal there is not the same demands made by the managers. The dismissal might be in the hands of the Council with a right of appeal secured to the teacher.

* * * * *

THE religious difficulty in the country parish where there is only one school ought to be capable of solution. Among all Christians there is much common ground. Take the Church Catechism. The Commandments, the Duties, the Lord's Prayer, the Creed, and the Desire are taught at present in Board Schools, and where the managers are not prepared to confine the religious instruction to these, the locality should have a second school. There would not be many places requiring the second school, for I believe the large body of the clergy would honourably stand by any such compromise.

* * * * *

THE advantages of such a solution need no demonstration. The cost of education would be removed from the locality to the State, to the advantage of education. The worst features of the dual system would disappear, and the progress of education would not be interfered with by continual religious strife. The existence of the dual system would no longer mean the starvation of the Voluntary Schools, and the eccentricities of the small School Board would be less harmful.

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WHAT a relief it is to be without the Annual Examination! I am just filling up the returns for the Department. The returns consist of Form IX. only —no schedules—with all the individual attendances. And how much calmer is the atmosphere of the school during the month before the examination. An epidemic of measles does not destroy one's rest, nor does the failure of the Fourth Standard to rise to 'three sums right out of four, one of which must be the problem,' send the teacher home distracted. No suspension of one subject to grind at another to save the grant. I know that for a time there will be misgivings as to the reform, but I feel sure that if we can get all schools under the new conditions there will be little desire to hark back.

* * * * *

THE other day I was drawing up a new Time Table for my school, and I found that, confining my-

self to a by no means too ambitious programme, I had to find time for such an array of subjects that might well make teachers and the Department pause.

* * * * *

TAKING the first three Standards I found—

Time at disposal - - - -			27½ hours per week
Religious Instruction	4	hrs.	
Recreation - -	1¾	,,	
Sewing or Drawing -	2½	,,	,,
Physical Drill - -	¾	,,	
Singing - - -	1	,,	
Registration - -	¾	,, = 10½	,, ,,
		17	,, ,,

In these 17 hours I had to provide for—

1. Recitation.
2. Reading.
3. English.
4. Geography.
5. Map Transcription.
6. Arithmetic.
7. Mental Arithmetic.
8. Word-building.
9. Composition.
10. Handwriting.
11. Object Lessons.
12. Suitable Occupations.

For the 17 hours I had twelve subjects; or, 1½ hours per week for each subject; or, 18 minutes a day for each subject.

* * * * *

SUPPOSING there was perfect regularity of attendance, and no continual harking back because half the class is always absent on Monday, the work could not be properly accomplished. Where is the chance of the teacher to introduce a little light and shade into the school-life? Is this the fare for little children of seven, eight, and nine years of age? Certainly not.

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No allowance seems to be made for the growth of the requirements in subjects like Drawing and Scripture. Gradually the Drawing requirements have increased in the first three Standards. The addition of Object Lessons even where taken *in lieu* of another Class Subject means increased work. What comparison can there be between the requirements in English in the First Standard, and thirty Object Lessons? The school life of our Primary School scholar is brief in the extreme. Too many never enter their names on the register until they are seven or eight years of age, and manage with the assistance of the Local Bye-Laws to leave at eleven, if not before. To fritter away these few short years in paper-cutting is ridiculous if not worse. Let us hope that Sir John Gorst will solve the problem by making Suitable Occupations an optional Class Subject.

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THE other day a teacher was describing how he taught spelling to a meeting of teachers. After a very exhaustive review of modern methods a teacher rose in the body, and said:—'I don't agree with all this nonsense about word-building and transcription. The teacher of the school next to mine follows that course, and when his scholars take home their papers they are marred by much blue pencil. In my school I just give out the piece thus:—"The boy stood on the burning deck; t-h-e b-o-y s-t-oo-d. When I go round to mark them there is seldom a single error, and when my scholars take home their papers the parents are well satisfied. My school is full, and my neighbour's is gradually emptying."'

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NEW YEAR'S SONG—'WHAT DO THE BELLS SAY?'

Lively, mf.

Treble
Alto
Bass

What do the Bells say? Oh, list-en! do list-en! They ring out so loud-ly through-out the still night. Can they

Key D. *mf.* Key A. t.

scold, do you think? Just now what a jang-le! They're clash-ing to-ge-ther with will and with might. What do the Bells say? Oh,

f. *f.* f. D.

list-en! do list-en! Per-haps they are tell-ing a-bout the old year; Per-haps they re-mem-ber the things we re-mem-ber, Per-

haps they know all that takes place, far and near.

What do the Bells say? Oh, listen! now listen!
They tell of the Christmas so happy and bright;
Of the Pudding and Goose, and burning Snap-dragon,
The Tree too, we had with its ribbons so bright.
What do the Bells say? Oh, listen! now listen!
They tell of to-morrow—at least that's to-day;
Of nice New Year's gifts, of the fun and the frolic,
Oh, listen! do listen to what the Bells say!

When the Bells stopped the young girls ceased to listen;
Their pretty eyes closed, and to dreamland they went,
Where sweet visions of joys to come flitted by them,
And happy scenes passed of the days they had spent.
What do the Bells say to all of us? listen!
They bid us be truthful, and earnest, and brave,
Remembering who told us to love one another,
Who lov'd us and suffer'd all mankind to save.

OUR SCOTCH LETTER.

1. 'In pios usus.' The wonderful union of apparently incongruous elements which go to form the average North Briton, is most conspicuous at the festive season of the New Year. Thus it is, or was till lately, not considered as at all out of place to see the citizen who had spent the most of the preceding night in the orgies of 'first-footing,' with its indispensable accompaniments of 'bun and whisky,' calmly, doucely and sedately assisting at the religious service in which so many of our denominations indulge, with the view of beginning the year well. Did the idea of penance enter into our Theology, the scales would fall from the eyes. At the least, however, it is but conformity to the established usage of making a good start. Even educational affairs have come under the influence, and the practice of holding the great palaver at this particular season, can only be explained by reference to the national aspiration.

2. 'Bonnie St. Johnstone.' The home of the Congress of the E.I.S. was this year the ancient city on the banks of the Tay, the centre of the historical fairy-land of Scotland. Intellectual attractions, however, had to suffice the visitor, as unfortunately a mist on both days veiled the surroundings so effectively as to prevent the due culture of the imagination. Indeed the members were quite entitled to the consolation afforded to one of our old nobility in somewhat similar circumstances. He had been out deer stalking, and having been caught in a wandered cloud, had the philosophy to lie down on the hill side till it passed. The mist, however, proved longer than the patience of his Lordship, who turned to his 'ghillie' and petulantly observed, 'What a . . . mist,' filling in the hiatus with a too common and forcible British dissyllable. 'It's the Lord's will,' was the quiet if somewhat fatalist reply of the domestic.

3. 'Two stars.' The proceedings of the gathering and the kernels of the learned disquisitions are available elsewhere to the profession and the public. Two subjects discussed demand a passing notice in this column. Spite of the agitation for enlarged School Board areas, now a matter of ancient history in Scotland, he would have been a bold man who two years ago would have ventured to prophesy the appearance of an Institute L.L.D. at the Congress of 1896 pleading for the inclusion of education in the operations of the County Council. It certainly had been mentioned in a Congress paper of the previous year. The reception accorded it, to say the least of it, could in no measure be said to have been enthusiastic. It speaks volumes for the 'iron-eating' properties of the small School Board to find such a remarkable advance in 'canny' Scotch opinion as is indicated in the willingness to entrust our only interest to the care of anybody which does not exist for that alone.

4. '"Mak" him a dominie.' The other, fitly complimentary, concerns our relations with ourselves. The gifted Rector of the Free Church Training College, Aberdeen, might appropriately have selected the following from the immortal Robin, as the text of his sermon,—

> 'Dull, conceited hashes
> Confuse their brains in college classes,
> They gang in stirks an' come oot asses,
> Plain truth to speak.'

Burns, with the assistance of his poetic fire, has only said a little more strongly what is being freely expressed on every hand regarding the finished product of our modern Training College. In addition to the inexorable logic of a short supply of teachers, the inutility of the professional training, fanciful or real, is undoubtedly running up the market value of the Ex. P. T. as a member of our school staff. Boards in several localities are taking to provide themselves with the cheap, home-made, pliable article, a fact which every lover of his country and profession is bound to deplore whatever be the inspiring cause.

5. 'The new Religion.' The Sloyd Association of Scotland now follows the Institute like a veritable handmaid. Whatever be the virtues of the newer occupation, they will not fail of appreciation for want of advocacy. 'In season and out of season,' the pertinacity of the Swedish-Scotch compels our admiration. A decided service was done to their cause by the meeting of this year. Despite all denials of the 'soft impeachment,' the idea was prevalent that the real though occult *raison d' etre* of the movement was increased mechanical manual dexterity. The opening address of the President, Mr. J. G. Kerr, put a new colour on the rose. Employing as he does several forms of manual instruction in his own school, Mr. Kerr's words are those of an authority. Its utility in his opinion consists largely in getting rid of the personal domination of the teacher. Children are in the ordinary school over instructed, and the teacher is associated too much as a matter of course with the process. Here is a chance of relief in which the pupil left to himself in greater measure may evolve and strengthen various faculties.

6. Counting the scalps. All things considered, the examining officials of the Department should find fewer ornaments of the vanquished order with which to decorate their wigwam from the Scholarship Examination of December 1895, than they were previously in the habit of capturing. The feeling is almost universal that with the exception of the History paper, the tests were pitched on a very much more moderate standard. What does this portend? It is a matter of notoriety that male teachers cannot be 'got for love nor money,' and that tension, desirable from the professional outlook, exists even in the female labour market. If the intention is, by a little judicious relaxation, to admit a greater number to the opportunity of full training, then it may be imagined little or no opposition would result. If, on the other hand, the loosening of the strings should eventuate simply in an enlarged third class, with its privilege of employment as ex-P.T., the floodgates will be opened. We may in the meantime 'labour and wait. 'For ways that are dark,' we can confidently lay in some preparation.

7. 'The mitherless bairn.' From this subject one naturally glides to the outcast of the profession, whose circumstances 'no man regardeth,' or from another point of view, who is nearly *regulated* out of existence. By the last issue of our Code, the P.T. was reorganized from top to toe. It can be known, only in the higher regions, how often the process has been repeated. Certainly the *genus* must be of the hardy order, or the numerous minutes would long ere this have made it 'a missing link.' Things would not be so bad if officialdom were bound by its own instructions. For

example, the new order of aspirants to the tawse and the desk were in the newest order of providence to be subjected to three examinations in their apprentice course, entrance, second year, and Scholarship. Greater breadth of study aimed at. Very well; but the Code which enacts the revolution came into force on 1st January last, and still P.T.'s of *all* years are for the present year of Grace to come up for examination. Looking back to the 'flesh pots of Egypt,' it is to be feared.

8. 'The year of Jubilee.' } The next September meeting of the Scottish Institute will be the fiftieth in its somewhat uneventful history. Following the recognized 19th century fashion, the 'fiery cross' is being passed round, in the hope of removing the significant stigma that the present membership amounts only to something between one third and one half of the qualified teachers of the country. Want of gratitude scarcely explains the anomaly, and so the drums are beating to quarters, and every effort is put forth for a large accession of recruits. Last year, if the auspicious season had happened to have fallen then, the reinforcement could have been relied upon. A great deal has happened, however, since the close of the official year in September last, which, rightly or wrongly, has raised the suspicion of a return in some measure to the days of the 'close corporation.' The question of the official element appears to be the trouble and the demonstration to which it gave rise at last annual meeting, does not seem to have been taken seriously enough. For the first time in its history the coming President is to be 'selected' by the votes of the members, and the experiment will be anxiously watched.

9. 'Stands Scotland where it did?' } It is, as yet, hardly possible to point the finger of scorn at us, in common with so many other parts of the civilized world, for desertion of 'the old ways.' The reputation of Presbyterian Caledonia has been gallantly 'snatched as a brand from the burning,' and by a body of teachers too. There is still one association in the far North, which will not suffer its time-worn privilege of 'extempore' opening prayer to fall a prey to the ruthless innovator, for the time called reformer. The younger element in the Glasgow Local Association have for some time, as was well known, looked upon the 'opening exercise' as an anachronism, the more so as Glasgow was the only teacher corporation in which the practice lingered. Two at least of the recent Presidents calmly and unblushingly eased their consciences by extracts from the Episcopalian Book of Common Prayer. The last bold *young* man omitted the ceremony entirely. Then the fat was in the fire, and after an animated debate, the ancient order of invocation was fully restored to all its rights and privileges. '*Nemo me impune lacessit.*'

10. 'Freeman stand or freeman fa'.' } The signs of the times give fair warning of a claim of right on the part of the class teachers. Lately they attacked inequality of salary with surprising success, and now they are going for status and rational employment. The idea of the Departmental system is 'taking on' with us. Originally, no doubt, it took its rise in the personal equation, the absurdity of highly educated and highly skilled men and women being condemned to be 'hewers of wood and drawers of water,' to a single standard or sometimes a part of one. It has now passed that stage. The benefit to education, which its adoption would secure, is generally recognized, and a brighter day seems near for the subordinate. All our maladies are the consequence of the weakness of the big school, and its defects have outrun the ingenuity which for a time coped with them. 'Three or four in one and one in the three or four,' is now the scholastic cry; the buildings are unfortunately much in evidence, and cannot conveniently be cut up; we must therefore be content with cutting up the inhabitants, and by so doing provide outlets for the skill and energy of our younger generation of teachers.

CIRCULAR TO H.M. INSPECTORS.

WORD BUILDING AND SPELLING.

Circular 375.

Education Department.
Whitehall, London, S.W.,
11th January 1896.

SIR,

THERE appears to be some ambiguity as to what may fairly be required of young children in an examination on Word Building, and also at what stages and to what extent it is advisable to teach the spelling of anomalous words as a necessary addition to a series of lessons on Word Building with normal words.

Word Building is a system of teaching by means of a course of progressive lessons, leading up from the formation of simple sounds to the composition of words by means of affixes and suffixes, and may be considered to consist of two distinct divisions:—

1. The building up of a single syllable, by assigning to it that combination of letters which usage has determined to be the conventional representation of its sound, which is the true inductive method of teaching spelling.
2. The combination of one or more of such syllables, of which a root word (*i.e.*, a word which cannot be reduced to a simpler form) is composed, with suffixes and affixes, such as the formation of nouns from adjectives, as *heavy, heaviness;* thus giving a training in the use of language.

The former process by itself would lead to correct spelling in the languages of countries which possess comparatively few cases of exceptional spelling. But the imperfections and inconsistencies of our English alphabet in representing many of the commonest sounds are so numerous that it might almost be said that in English we virtually possess two separate languages, a spoken language and a written language, the one appealing to the ear, the other to the eye.

It is not possible consequently to separate the spelling of anomalous words entirely from Word Building, because a purely phonetic method of spelling English words cannot be used; therefore, after dealing with a group of words connected by a common spelling of the same sound, and so reducing a considerable number of English words to certain visible and intelligible principles, the teaching should embrace the spelling of some few exceptional words of common use, which convey the same sound by a different combination of letters, though such instruction lies quite outside the progressive course of lessons on Word Building. It should be clearly understood that such lessons are subordinate to the Word Building, and should not be considered as a real test of a good series of Word Building lessons. In selecting the exceptions to be taught it would be wise to select such anomalous words as are in common use.

A clear distinction may be helpfully drawn between the methods of teaching groups of regular words formed by Word Building and exceptions to the rules. In teaching, the former should be spoken before they are written on the blackboard, to connect more firmly the sound with its ordinary combination of letters; the latter should be written on the blackboard before they are spoken, so that the teacher may be able to disconnect the same combination from its ordinary pronunciation.

The Word Building lessons in infant schools may be usefully restricted to the simple phonic teaching of the more common of the different sounds represented by the letters of the alphabet. It should be possible in infant schools to teach simple combinations which might include, for example, all the simpler closed syllables; while relegating to the schools for older scholars such difficult varieties of sound as are conveyed, for instance, by the three sounds

of the combination 'ch' in chin, charade, and chasm. But the chief part of the Word Building will, in the upper schools, consist of the combination of root words with suffixes and affixes, which might be progressive in difficulty, rising from such simple forms as the more common terminations of nouns and adjectives and the suffixes denoting gender, to the formation of adverbs from adjectives or prepositions, or other difficult combinations. There is no better exercise of the inductive method of reasoning, nor one more intelligible and interesting to young children, than verbal analysis, *i.e.*, the exact investigation of the several parts of familiar words. The addition, for example, of the suffixes *en*, *er*, *est*, *ly*, *ish*, and *ness* to the word sweet, and the use of words so found in short sentences, will lead the scholars by simple induction from these and other similar words to determine for themselves the exact meaning of each suffix.

Any course of Word Building proposed for your approval should be sanctioned if it follows the following rules :—

1. The classes of words proposed to be taught should be plainly set out, in progressive order, *i.e.*, words that can be taught both through the eye and the ear.
2. The anomalous words, or words which form exceptions to these rules, which can be taught by the eye only; should be also set out in lists submitted to the Inspector and limited to words in common use, and in any examination which you may hold no others should be expected to be spelt.

Some freedom may be permitted as regards different modes of spelling the same word, as inflexion and inflection, bylaw and bye-law, judgment and judgement.

I have the honour to be, Sir,
Your obedient Servant,
G. W. KEKEWICH.

LEGAL AND CODE QUERIES COLUMN.

☞ *N.B.—Our Replies in this column are not restricted to matters which are strictly professional. We shall be pleased to answer questions on legal difficulties which arise in connection with the private business of our readers, and also to give information on subjects of general interest. In fact, we will spare no trouble which may be necessary in order to answer in this column any reasonable question forwarded by a reader.*

RULES.

1. All communications must be addressed 'Legal Editor, PRACTICAL TEACHER, 33, Paternoster Row, E.C.,' and must be accompanied by our 'coupon,' duly filled up.
2. Replies will be given *only* in this column, except under the conditions named in Rule 3.
3. If any reader desires a reply by post, such can be forwarded by enclosing, in addition to the coupon, a stamped addressed envelope and either stamps or a Postal Order to the value of one shilling.
4. No original documents should be forwarded, but copies only. We cannot hold ourselves responsible for any losses which occur through non-observance of this rule.

Word Building.—'M.G.'—Your question is most fully answered in the Circular recently issued by the Education Department. It is dated 11 January, 1896, and appeared in the weekly Educational papers a few days since.

School Museums.—'R.T.G.'—The articles do not belong to you; but if the managers raise no objection you can with safety carry out your proposed plan.

School Report.—'RE-EXAMINEE.'—Certificated Teachers coming up for re-examination under Art. 62 of the Code are not required to obtain a fresh report under Art. 57 (ii) of. the Code.

Log Book.—'PUZZLED.'—The decisions of the Department on this matter appear to be conflicting. This is the latest :—'The Managers are held responsible by the Department for the provision of a Log Book (Art. 8 (*c*) of the Code), and this book should be under the control of the Managers at all times, though most of the entries in it must be made by the principal teacher. The note to Art. 8 forbids the making in the Log Book of reflections or opinions of a general character.' You will note the phrase: 'most of the entries.'

Breach of Promise.—'GERTIE.'—You have been treated badly, but you should consult personal friends and relations older than yourself as to whether it is advisable to further notice the matter. Legally, you *have* good grounds for an action, but legality is not the only consideration in such a case.

Drawing.—'RURAL MISTRESS.'—You should get a copy of 'The New Illustrated Drawing Syllabus.' It can be obtained from John Menzies & Co., 12, Hanover Street, Edinburgh. Price 4½d. I name the Scotch publishers, as I note you address from Perth.

Landlord and Tenant.—'M.S.'—If you will send me on an exact copy of the lease, I will gladly advise you. On your statement I have formed the general opinion that your claim is a good one, but without the lease before me it is impossible to give definite advice.

Certificate.—'A.H.'—(1) No problems in Mental Arithmetic. (2) Read the last sentence in Art. 57 (i) (*b*) of the Code. The Inspector may require you to give a lesson before him. (3) Parsing, Analysis, and the principles of Grammar—and a thorough knowledge of Gray's Poems and Milton's Tractate on Education.

LOAN EXHIBITION OF ENGLISH FURNITURE AND FIGURED SILKS OF THE 17th AND 18th CENTURIES.

THE Lords of the Committee of Council on Education have directed the formation, at the Bethnal Green Museum, of a loan collection of examples of English furniture and figured silks of the 17th and 18th centuries, which will be opened in April 1896, in the galleries recently occupied by the national portraits which are now removed to Trafalgar Square.

IN order to ensure the formation of a thoroughly representative collection, the assistance has been invited of a number of gentlemen eminently qualified by their knowledge to advise with regard to these branches of industrial art, which still form, as they did in the past, the main handicrafts of the East of London.

The interest taken on the Continent in English 18th century furniture is shown by the fact that Commissions have recently come from Germany and Austria to inspect the examples of the works of Chippendale, Sheraton, and Hepplewhite in the South Kensington Museum, and to secure authentic specimens, or good copies, for the Commercial Museums of Strasburg and Vienna.

Recent changes of fashion have caused a demand for 18th century patterns in figured silks, the manufacture of which formerly gave employment to 60,000 weavers in the East of London, and the designs of the early days of George III. are now being revived or adapted. Possessors of dresses and costumes made of these silks will be invited to lend them for exhibition, and as 18th century trade pattern books —which attach to cut examples of the silks the names of weavers and merchants—will be included, comparisons between the designs in these samples and the patterns in the old costumes will probably lead to greater accuracy in dating the English figured silks already in the possession of the Museum.

The loan collection will remain open for six months; and, in addition, the Bethnal Green Museum will be enriched by the generous loan by Sir Wollaston Franks of his collection of European porcelain, and by the Chantry Bequest collection of pictures lent by the Royal Academy.

MENTAL ARITHMETIC FOR THE STANDARDS.

BY T. B. ELLERY, F.R.G.S.,
President of the National Union of Teachers.

'*Mental work will strengthen the power of computation, and facilitate the handling of simple problems.*'—MR. CODD, H.M.I.S.

Eighth Paper.

STANDARD V.

THE Arithmetic set for children in this Standard is as follows:—

Scheme A.—Practice, bills of parcels, and single rule of three by the method of unity. Addition and subtraction of proper fractions, with denominators not exceeding 12.

Scheme B.—Vulgar fractions (simple fractions only). Practice, bills of parcels, common weights and measures.

In connection with this I would point out that the Inspectors are informed in the *Instructions*, that 'In neither Scheme is the difficult portion of the table of length or the table of area now required before the Sixth Standard.' The note to the Arithmetic in Schedule I. should also be remembered: 'Short exercises in Mental Arithmetic should be given in all Standards. These should not involve large numbers, should from the first deal with concrete as well as abstract quantities, and should be preparatory to the work of the next higher Standard during the last quarter of the school year.'

1. *Aliquot Parts.*

'Aliquot parts' should be well-known at this stage. Readiness in working practice sums will depend upon this. Here are a few examples by way of suggestion.

1. What part of £1 is 10s.? 5s.? 2s. 6d.? 2s.?

2. What part of £1 is 1s. 8d.? 1s. 4d.? 1s. 3d.? 1s.? 6d?

3. What part of £1 is 4d.? 3d.? 2d.? 1d.? ½d.? ¼d.?

4. What part of 5s. is 2s. 6d.? 1s. 3d.? 7½d.? 3¾d.?

5. What part of 10s. is 3s. 4d.? 1s. 8d.? 1s. 3d.?

6. What part of 2s. is 6d.? 4d.? 3d.? 2d.? 1d.?

7. What part of 1s. is 6d.? 4d.? 3d.? 2d.? 1½d.? 1d.?

8. What part of 2s. 6d. is 1s. 3d.? 7½d.? 6d.? 3d.? 1d.?

9. What part of 6d. is ½d.? ¼d.? ¾d.?

10. What part of 3d. is 1½d.? 1d.? ½d.? ¾d.?

11. How often is 2 cwt. contained in 1 ton? 5 cwt. in 1 ton? 2½ cwt. in 1 ton?

12. How often is 1 qr. contained in 1 cwt.? in 1 ton? 56 lb. in 1 cwt.? 28 lb. in 1 cwt.? 14 lb. in 1 cwt.?

13. How often is 2 stone contained in 1 cwt.? in 10 cwt.? in 1 ton?

14. How often is 56 lb. contained in 1 ton? 8 stone in 1 ton? 1 lb. in 1 ton?

15. How often is 4 oz. contained in 2 lb.? 8 oz. in 6 lb.? 12 oz. in 3 lb.?

16. How often is 1½ oz. contained in 3 lb.? 2 oz. in 3 lb.?

17. How often is 6 in. contained in 1 yd.? 3 in. in half a yd.?

18. How often is 9 in. contained in 2 yd.? 8 in. in 2 yd.?

19. What part of a gallon is 1 qt.? 1 pt.? ½ pt.?

20. What part of a peck is 1 qt.? 1 pt.?

21. What part of a bushel is ½ pk.? ½ gal.?

22. How many pints in 3 gallons? in 1 peck? in a bushel?

23. How often is 15 min. contained in 2 hr.? 30 min. in 3 hr.?

24. What part of a day is 2 hr.? 1 hr.? 30 min.?

25. What part of an hour is 30 sec.? 1½ minute?

2. *Simple Fractions.*

1. Add $\frac{1}{4}$ and $\frac{1}{5}$.

2. Add $\frac{1}{3}$ and $\frac{1}{8}$.

3. Add $\frac{1}{5}$ and $\frac{1}{6}$.

4. Take $\frac{1}{5}$ from $\frac{1}{3}$.

5. Take $\frac{1}{12}$ from $\frac{1}{10}$.

6. Add $\frac{1}{3}$ and $\frac{1}{5}$ and take your answer from unity.

7. What must you add to the sum of $\frac{1}{2}$ and $\frac{1}{4}$ to make 1?

8. What must you add to the sum of $\frac{1}{6}$ and $\frac{3}{4}$ to make 1?

9. By how much does $\frac{3}{4}$ exceed $\frac{1}{8}$?

10. $\frac{5}{6} - \frac{1}{2}$; $\frac{3}{5} - \frac{3}{10}$; $1 - \frac{2}{5}$.

11. Take $\frac{3}{4} - \frac{1}{6}$ from $\frac{7}{10}$.

12. I gave $\frac{1}{5}$ of an apple to one boy and $\frac{1}{3}$ to another. What fraction of the apple did I give away?

13. I gave $\frac{1}{3}$ of an apple to one boy and $\frac{1}{6}$ to another. What fraction of the apple had I for myself?

14. Add $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{6}$.

15. Add $\frac{1}{4}$, $\frac{1}{8}$, $\frac{3}{8}$.

16. Add $\frac{2}{3}$ and $\frac{1}{6}$ and take your answer from 1.

17. Take $\frac{1}{8}$ from $\frac{1}{2}$ and take $\frac{1}{4}$ from your answer.

18. Add $\frac{1}{3}$ and $\frac{1}{4}$ and take $\frac{1}{12}$ from your answer.

19. How many eighths are there in $\frac{3}{4}$? $\frac{1}{2}$? $\frac{1}{8}$?

20. Express $\frac{2}{3}$ as a fraction whose denominator is 9.

3. *Rule of Three.*

1. If 2 men earn 6s. 0d., what will 3 men earn?

2. If 3 lb. of tea cost 4s. 6d., what will 4 lb. cost?

3. 16 men build a wall in 4 days. How long would 8 men take?

4. 12 men do a piece of work in 8 days. How many men would be required to do it in 6 days?

5. 24 lb. sugar cost 3s. What would 16 lb. cost?

6. A man travels 240 miles in 8 days. How far, at this rate, would he travel in 10 days?

7. A man earns a guinea in 6 days. How long, at this rate, would he take to earn £1 11s. 6d.?

8. If a man run 200 yd. in 26 sec., how long, at this rate, would he take to run 300 yd.?

9. A man saves 16s. 0d. in 12 days. How much, at this rate, would he save in 20 days?

10. 9 men do a piece of work in 12 days. How many men would be required to do it in 36 days?

11. If 1 qr. 2 lb. of soap cost 2s. 6d., what would ½ cwt. cost?

12. If a farmer pay £40 for 16 sheep, how many can he buy with £90?

13. 30 fowls cost £4 10s. What, at this rate, would 45 fowls cost?

14. If $2\frac{1}{2}$ dozen books cost £3, what would you pay for 20 books?

15. A man's earnings in 36 hours amount to £1 7s. How much would he earn in 54 hours?

4. *Bills.*

1. $3\frac{1}{2}$ lb. of tea at 2s. 6d. per lb.?
2. 1 qr. 2 lb. of candles at 6d. per lb.?
3. $\frac{1}{2}$ cwt. rice at $1\frac{1}{2}$d. per lb.?
4. $1\frac{3}{4}$ lb. beef at 8d. per lb.?
5. $7\frac{1}{4}$ lb. mutton at 10d. per lb.?
6. $8\frac{1}{2}$ lb. veal at 11d. per lb.?
7. 17 yd. silk at 2s. 6d. a yd.?
8. 20 yd. lace at $4\frac{1}{2}$d. a yd.?
9. 18 yd. carpet at 1s. 11d. a yd.?
10. 2 qt. 1 pt. milk at $2\frac{1}{2}$d. a pint?
11. 2 gal. 2 qt. ink at 3s. 6d. a gal.?
12. 9 pints of milk at 1s. 4d. a gal.?
13. 50 apples at 5 for 3d.?
14. $2\frac{1}{2}$ doz. oranges at 3 a penny?
15. 80 pears at 4 for 6d.?
16. $3\frac{1}{2}$ doz. yd. braid at 6 yd. for 4d.?
17. 100 reels of cotton at 8 for 1s.?
18. $1\frac{1}{2}$ cwt. rice at 1d. a lb.?
19. $\frac{3}{4}$ cwt. sugar at $1\frac{1}{2}$d. a lb.?
20. 7 lb. of cheese at $9\frac{1}{2}$d. a lb.?
21. ¼ cwt. cheese at 10d. a lb.?
22. 4 lb. 8 oz. butter at 1s. 4d. lb.?
23. What change from a sovereign after paying for 16 lb. of beef at 8d. per lb.?
24. Give change from a sovereign in the following bill:—$8\frac{1}{2}$ lb. of butter at 1s. 6d. a lb.?
25. A woman bought 6 lb. of cheese at 9d. a lb., and 8 loaves at $4\frac{1}{2}$d. each. How much less than half a sovereign did she spend?

5. *General.*

1. Find the value of 27 articles at 1s. 6d. each.
2. Find the G.C.M. of 36 and 54.
3. Find the L.C.M. of 4, 6, 8, 12.
4. Find the value of $\frac{1}{5}$ of £1; $\frac{3}{5}$ of 10s.; $\frac{5}{6}$ of a sovereign.
5. Find the value of $\frac{2}{3}$ of a guinea; $\frac{3}{4}$ of 18s.; $\frac{7}{9}$ of 1s. 6d.
6. I spend $\frac{1}{6}$ of my money, and have 6d. left. What had I at first?
7. I spend $\frac{7}{8}$ of my money, and have 5s. left. What sum had I at first?
8. What vulgar fractions are equivalent to ·5? ·25; ·75?
9. Multiply ·25 by 10, and by 100.
10. Multiply ·123 by 100, and by 10.
11. Divide ·8 by 10, and by 100.
12. Divide ·04 by 10 and by 1,000.
13. How often is ·25 contained in ·5? in ·75? in 1?
14. What is the value of ·5 of 10s. + ·25 of £1?
15. What must you add to ·75 of 12s. to make half-a-sovereign?
16. A man had 120 sheep. He sold one-half, and then one-third of the remainder. How many had he then?
17. Find the value of $(\frac{1}{3} + \frac{1}{3})$ of 6s.
18. How often is $\frac{3}{5}$ of a crown contained in £2?
19. Add $\frac{1}{3}$ of a crown and $\frac{1}{6}$ of a sovereign.
20. A bankrupt pays 2s. 6d. in the £. What does he pay on a debt of £640?
21. Express in decimals $\frac{3}{10}$; $\frac{17}{100}$; $\frac{9}{1000}$.
22. Find the difference between 9^2 and 5^2.
23. Multiply 685 by 25.
24. Multiply 158 by 125.
25. I spend $\frac{7}{20}$ of £1. What fraction is this of a guinea?
26. Simplify $\frac{\frac{3}{4} + \frac{1}{2}}{5}$.
27. 5 per cent. on £5? $2\frac{1}{2}$ per cent on £10?
28. Find the simple interest on £400 in 2 years at 4 % p.a.
29. Find the simple interest on £250 in $2\frac{1}{2}$ years at 2 % p.a.
30. Find the simple interest on £20 in 8 years at $12\frac{1}{2}$ % p.a.
31. A room is 18 ft. long and 12 ft. wide. What is the area of the floor?
32. A hall is 54 ft. long and 30 ft. wide. Find the area.

QUERY COLUMN.

R. (*Arbroath*).—A person buys 6 per cent. bonds, the interest on which is payable yearly, and which are to be paid off at par, three years after the time of purchase. If money be worth 5 per cent., what should he give for the bonds?

If money is worth 5 per cent, £1 at the end of 1 year becomes $£1\frac{1}{20}$, and at compound interest at the end of 3 years becomes $£(\frac{21}{20})^3$.

Suppose he pays £A for the bonds. The price should be such that the amount of £A at compound interest for 3 years at 5 per cent. should equal what he will obtain by (a) repayment value of the bonds, together with (b) amount at compound interest of the interest received on the bonds.

Compound interest of £A for three years at 5 per cent.
$$= A \times (\tfrac{21}{20})^3.$$

The £6 interest received at the end of the first year is at compound interest at 5 per cent. for 2 years, that received at the end of the second year bears interest for one year, that received at the end of the third year bears no interest.

∴ Amount received by repayment of the bonds + amount of interest received on the bonds and compound interest on this interest

$$= £100 + £6 + £(6 \times \tfrac{21}{20}) + £(6 \times (\tfrac{21}{20})^2)$$
$$= £100 + £6 + £6\tfrac{3}{10} + £6\tfrac{123}{200}$$
$$= £118\tfrac{123}{200}.$$

$$\therefore A \times \left(\tfrac{21}{20}\right)^3 = £118\tfrac{183}{800};$$

$$\therefore A = £118\tfrac{183}{800} \div \left(\tfrac{21}{20}\right)^3$$

$$= £\frac{23783}{200} \div \frac{9261}{8000}$$

$$= £\frac{23783 \times 8000}{200 \times 9261}$$

$$= £\frac{951320}{9261}$$

$$= £102\ 14\text{s.}\ 5\tfrac{3887}{9261}\text{d.} = \text{price of the bonds.}$$

Herne Hill.—A golden candlestick is suspended from the roof of a hall by a chain, and vibrates 1,000 times an hour. The distance from the roof to the candlestick is a mean proportional between the height of the roof and the height of the candlestick. What is the height of the hall?

Let AB = length of chain,

BC = height of candlestick from the floor.

Then AB + BC = height of hall.

By the terms of the question

$$BC : AB :: AB : AB + BC.$$

Assuming that the formula for the time of vibration of a simple pendulum is applicable here, and neglecting the resistance of the air, if t = time of one oscillation in seconds, $\pi = 3\frac{1}{7}$, r = length of pendulum in feet, and g = acceleration due to gravity, here estimated at 32 feet per second,

$$\text{Then } t = \pi\sqrt{\frac{r}{g}}.$$

$$\text{But } t = \frac{1 \text{ hr.}}{1000} = 3\tfrac{3}{5} \text{ sec.} \quad \text{And } r = AB.$$

$$\text{Then } 3\tfrac{3}{5} = 3\tfrac{1}{7}\sqrt{\frac{AB}{32}}.$$

Square both sides.

$$\text{Then } \frac{324}{25} = \frac{484\ AB}{1568} = \frac{121\ AB}{392}.$$

$$\therefore AB = \frac{392 \times 324}{25 \times 121} \text{ feet} = 41{\cdot}9 \text{ feet}.$$

But since $BC : AB :: AB : AB + BC$,

$$\therefore BC\,(BC + AB) = AB^2,$$

$$\therefore BC^2 + BC.AB = AB^2.$$

Substitute the value for AB already found.

$$\therefore BC^2 + 41{\cdot}9\ AB = 1755{\cdot}61.$$

Complete the square.

$$\therefore BC^2 + 41{\cdot}9\ AB + (20{\cdot}95)^2$$

$$= 1755{\cdot}61 + 438{\cdot}9025$$

$$= 2194{\cdot}5125.$$

$$\therefore BC + 20{\cdot}95 = \sqrt{2194{\cdot}5125}$$

$$= 46{\cdot}84.$$

$$\therefore BC = 46{\cdot}84 - 20{\cdot}95$$

$$= 25{\cdot}89 \text{ feet}.$$

$$\text{Height of hall} = AB + BC$$

$$= 41{\cdot}9 \text{ feet} + 25{\cdot}89 \text{ feet}$$

$$= 67{\cdot}79 \text{ feet}.$$

Pax (Gibraltar).—Will you kindly send your address to the office of this Journal?

COURSE 'B' IN ARITHMETIC.

A COMPLETE SYLLABUS FOR A YEAR IN MONTHLY SECTIONS, WITH TESTS.

BY B. ELDERKIN,
Model School, Westminster Training College.

Introductory Notice.

Scheme 'B' is set out in Schedule I. 'as an alternative to the ordinary Standard Course.'

The special feature of the Scheme is that only small numbers should be used, and the teacher must aim at teaching *processes* and the functions of numbers, rather than at securing mechanical skill in working 'sums.'

The Scheme is at once more rational, useful, and more *human* than the old one, and its adoption will be a great gain to both teacher and taught.

We give a few hints as to how the Scheme should be worked, and then it is our intention to supply a 'Month by Month Syllabus,' together with a 'Test' (with correct answers), which must be regarded solely as a standard to be aimed at, and not as indicating the methods to be adopted in teaching.

If the Monthly Syllabus for any class should be found to contain too much work, a portion of it may be transferred to another month, and that part of the test varied accordingly. Also where several sums (marked *a*, *b*, *c*, *d*, etc.) are given as one, it may be desirable to lessen the work required of each child by allowing one to work (*a*), the next (*b*), and so on.

The Syllabus will be completed in nine months, and the last three months will be devoted to revision.

Hints:—

(*a*) Keep rigidly to the *simplest* numbers in teaching.

(*b*) Work as far as possible in the *concrete*. A ball-frame or a *box of matches*, with brimstone cut off, will be found useful. Always give *each* child as many objects as will cover the numbers employed until they can be dispensed with.

(*c*) Build up all the tables in the concrete, and add and analyse the numbers to teach the idea of multiplication and division while the tables are being formed and learned.

(*d*) Let the chief part of the work be done *mentally*. Only use slates or books when the child has learned something to put down. Even then use them sparingly.

Standard I.

Syllabus—1st Month.

(*a*) Addition in two figures.
(*b*) Subtraction of numbers up to 20.
(*c*) Twice times table.

Test.

1. How many trees are 16 and 24 and 15 and 38 trees?

2. (*a*) Take 9 from 14.
(*b*) How much is 12 less than 20?
(*c*) How much is 15 greater than 8?
(*d*) How many must I add to 9 to make 13?

3. If there are 12 boys in the 1st class, 25 in the 2nd class, 16 in the 3rd class, and 10 in the 4th class, how many boys are there in the school?

4. How much are—

twice times 3
" " 5
" " 8
" " 9
" " 12

Standard II.

Syllabus—1st Month.

(*a*) Seven times table.
(*b*) Pence table, to 30 pence.
(*c*) Addition and subtraction of money to 24d.

Test.

1. John earns 6d. a day, William 5d. a day, James 7d. a day, and their father 10d. a day. How much do the family earn in one day?

2. (*a*) How much is 9d. greater than 4d.?
(*b*) If I have 10d., how much more to make a shilling?
(*c*) How many threepences make a shilling?

3. If I spend 6d. on Monday, 3d. on Tuesday, 4d. on Wednesday, 5d. on Thursday, how much should I have left out of 2s.?

4. (*a*)

7 times 9
7 " 4
7 " 6
7 " 11
7 " 3

(*b*) How much are—

20 pence
16 "
28 "
14 "

Standard III.

Syllabus—1st Month.

(*a*) Addition to three figures.
(*b*) Subtraction to three figures.
(*c*) Multiplication with multipliers not exceeding 12.
(*d*) Division with divisors not exceeding 12.

Test.

1. 309 + 75 + 119 + 603.
2. If John has 518 marbles, how many more has he than James, who has 349?
3. A box of oranges contains 672. How many oranges are there in 8 similar boxes?
4. Divide 5,082 sheep into 7 flocks. How many are there in each flock?

STANDARD IV.

Syllabus—1st Month.

Long Measure, with exercises in the four rules, up to and including 12 as multiplier or divisor.

Test.

1. Add together 3 yds. 2 ft. 5 ins.; 18 yds. 1 ft. 7 ins.; 3 yds. 18 ins.; and 5 yds. 4 ins.
2. There are two pieces of calico, one 3 yds. 2 ft. 9 ins., the other 5 yds. 1 ft. 6 ins. long. How much is the second longer than the first?
3. How many yards would there be in 3 pieces of carpet each 2 yds. 1 ft. 8 ins. in length?
4. Divide 16 yds. 2 ft. 10 ins. into 5 equal portions.

STANDARD V.

Syllabus—1st Month.

(*a*) G.C.M.
(*b*) L.C.M.
(*c*) Notions involved in a Fraction.
(*d*) Conversion of mixed numbers into Improper Fractions.
(*e*) Reverse of '*d*.'
(*f*) Reduction of Fractions to higher or lowest terms, with or without G.C.M.
(*g*) Find Common Denominator.

Test.

1. Find L.C.M. of 3, 4, 5, 6, and 10, and G.C.M. of 352 and 1155.
2. Change $5\frac{3}{15}$ into an Improper Fraction, and $\frac{78}{4}$ into a mixed number.
3. How many 48ths are there in $\frac{5}{8}$, also in $\frac{11}{12}$, and also in $\frac{15}{24}$?
4. Reduce $\frac{3}{4}$, $\frac{5}{6}$, $\frac{3}{5}$, and $\frac{7}{8}$ to equal Fractions, having a Common Denominator.

STANDARD VI.

Syllabus—1st Month.

(*a*) Meaning of Decimal Notation, with place value of each figure up to $\frac{1}{10000}$.
(*b*) How to express Decimals as Vulgar Fractions, and conversely.
(*c*) First four rules of Decimals.

Test.

1. Express ·005 and 13·08 as Vulgar Fractions; also $\frac{7}{16}$ and $75\frac{1}{2}$ as Decimal Fractions.
2. Add together 5·14; 3·164; 9·87; 65, and ·381, and subtract the answer from 1,000.
3. (*a*) Multiply ·51 by 17·6; and (*b*) ·008 by ·059.
4. (*a*) Divide 13·72 by 4·196; and (*b*) 2250 by ·0015.

STANDARD VII.

Syllabus—1st Month.

(*a*) Meaning of and simplification of Compound Fractions.
(*b*) Easy Complex Fractions, involving first four rules and the use of brackets.

Test.

1. Simplify $(\frac{1}{2}$ of $2\frac{3}{5}) \times (\frac{9}{10}$ of $\frac{4}{21})$.
2. ,, $\dfrac{\frac{3}{4} + \frac{5}{6} - \frac{1}{2}}{\frac{5}{14} \times \frac{7}{10}}$.
3. ,, $\dfrac{\frac{3}{5} \times \frac{5}{6} \times \frac{2}{15}}{\frac{1}{2} - \frac{1}{6}}$.
4. ,, $\dfrac{5}{6} + \dfrac{2}{3}$ of $1\dfrac{1}{5} + 5\dfrac{1}{4}$.

ANSWERS—FIRST MONTHLY TEST.

Standard I.—None required.

Standard II.—(1) 2s. 4d.; (2) None required; (3) 6d.; (4) None required.

Standard III.—(1) 1106; (2) 169; (3) 5376; (4) 726.

Standard IV.—(1) 30 yds. 2 ft. 10 ins.; (2) 1 yd. 1 ft. 9 ins.; (3) 7 yds. 2 ft.

Standard V.—(1) (*a*) 60; (*b*) 11. (2) (*a*) $\frac{78}{8}$; (*b*) $19\frac{1}{2}$. (3) $\frac{12}{48}$, $\frac{20}{48}$, $\frac{32}{48}$. (4) $\dfrac{18, 20, 16, 21}{24}$.

Standard VI. — (1) (*a*) $\frac{1}{2000}$, $13\frac{2}{25}$; (*b*) ·4375, 75·015625. (2) 870·445. (3) (*a*) 3·876; (*b*) ·000472. (4) (*a*) 3·2697; (*b*) 1500000.

Standard VII.—(1) $\frac{3}{10}$; (2) $6\frac{2}{3}$; (3) $\frac{5}{21}$; (4) $31\frac{1}{20}$.

EDUCATION ABROAD.

CONSIDERING that there are a thousand million people in the world, and that one-third of these are children under 15 years of age, we are face to face with the notable fact that there are at the present moment over three hundred million souls undergoing a mental development which requires careful and experienced superintendence. This is the world's educational task—a task which in every civilised or semi-civilised country falls chiefly to the lot of the professional teacher. To survey the international field of education, to make the lessons taught by foreign experiment and experience available for our readers, and to promote a feeling of kinship between all engaged in the noble and responsible work of informing the youthful mind—these are the objects to which these columns are devoted.

* * * * * *

THE Cuban insurrection is about to be utilised by American teachers as an object-lesson in patriotism and tropical geography. Miss Anna Buckbee, in the *Journal of Education*, writes:—

'The insurrection now in progress affords the teacher of America a grand opportunity. Rightly used, we may teach the geography of the tropics far more effectively through the interest that can be now aroused in the people who live there. This revolt can also be made the basis for the important topic of colonial history, thus helping to a better understanding of our own struggle for independence. We can reinforce patriotism, and increase the appreciation of the blessings which our forefathers fought for and bequeathed to us.'

* * * * * *

THE teachers of the Belgian province of Hainaut are taking energetic steps to obtain redress for a substantial grievance. It appears that their pensions are calculated upon the basis of the average salary of their five last years of service. The Legislature, no doubt, framed this law with an idea of procuring the most favourable terms for the teachers. But many communal teachers in Belgium draw reduced salaries towards the close of their activity, and they are now petitioning the Legislature to fix their pensions upon the basis of the average salary obtained during their best-paid five years of service. They are also asking for a maximum pension of three-quarters of their salary, like other civil servants, instead of two-thirds, as at present.

* * * * * *

THE Manitoba School Question is likely to give some trouble to the Colonial authorities yet. Briefly stated, the difficulty is this. In the year following the incorporation of Manitoba as part of the Dominion of Canada (1870), a system of denominational education was established, with separate Protestant and Catholic Boards. The Protestant majority soon commenced an agitation for an Education Department controlling a system of non-sectarian schools, and compelling the use of English text-books. A measure to that effect was passed in 1890 by the Manitoba Legislature, but has since been fought in Manitoba, in Ottawa, and in London by the Roman Catholics, the Anglicans, and the Mennonites. The case for denominational education was defeated in the Manitoba Courts, supported on appeal to the Supreme Court of Canada, and finally defeated before the Privy Council. But eventually an appeal to the 'Governor-General in Council' was allowed, and in March 1895 the latter gave a Remedial Order in Council declaring that it seemed requisite that the privileges lost to Roman Catholics should be restored to them by a new Provincial Act. No action has, however, been so far taken by Manitoba to amend the Act of 1890, and a popular agitation is threatened in case of any attempt to do so.

THE first public Girls' College of Chili has been inaugurated at Santiago.

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A THOUGHTUL Article on the higher education of Indian women appears in the *Educational Review* (Madras), from the pen of Miss A. Subrahmanyam—

'For some years past,' she says, 'our Government has been showing considerable amount of solicitude in the intellectual elevation of our women. But, in their education in the full and proper acceptation of the term, we are encountered by a practical difficulty. Our marriage law and national custom prohibit us from allowing our girls to remain at school after a certain age. That age is supposed by us to be the age of transition in the life of a girl. It is believed that to allow her to continue at school after that age is to do violence to the sanctity of her life. So she is withdrawn from school by the parents, sometimes even long before the arrival of the expected epoch, and retained at home under their own direct supervision and control. We should certainly have no reason to complain if, after she is thus chained down to her house, her education were looked after under proper guidance and supervision. But no such thing is ever known to take place. It is indeed deplorable that during an important period of brain growth, when all the various faculties are gradually drawn out, her course of instruction should be suddenly arrested, and her education should thereafter be made to consist in the learning of the kitchen work and domestic economy.'

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IN connection with this timely comment, we are pleased to notice the success of a new departure made by the Maharani Girls' School, Mysore. This is :—

'The arrangement made by the school committee for imparting instruction to grown-up girls in their homes after they were withdrawn from school. The first batch of students who joined the Home Education Classes, were all of them ex-pupils of the school. But the elderly orthodox native Pundists (scholars), who were employed to do this work, commanded the respect and confidence of even conservative Hindu parents, and hence the scheme soon became so very popular that even those grown-up girls and women who had not received any education at all before, were induced to seek admission to the Home Classes. When the conservative Hindu women, who were at first dead against female education of any kind, found that what the Home pupils learnt was precisely what they would wish all Hindu girls to learn, they not only encouraged the Home students in their studies, but also became desirous that the girls of their own families, who had not been fortunate enough to receive a school education, should share the benefits of this instruction at least.'

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THE question of child labour in Germany is vigorously dealt with by J. Tews in the *Deutsche Blätter*. Although stringent laws are in force regulating the admission of children to factories and their working hours, many ways have been found of evading them. Thus it is customary to employ school children in the brickfields, whither they accompany their parents after school hours, to take part in the work 'for the fun of it.' Again, the home industries cannot be subjected to the searching rules governing a factory. Boys are known to work at grinding knives in the Solingen cottages for fifteen hours per day. Similarly, the exclusion of child labour from cigar factories has led to their increasing employment in an uncontrolled home industry, and all the inmates of the house suffer from the unhealthy trade. The only remedy which the author sees is some way of increasing the remuneration of the worker with the growth of his family. To accomplish this by State measures does seem rather an 'advanced' idea.

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GYMNASTICS have been made compulsory in six Austrian State high schools (Gymnasien). In Germany, as we know, it has for years been compulsory in all. In both countries two hours per week is the minimum fixed, and in Austria they are to be chosen as early as possible in the morning.

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PROFESSOR Emilio Gonzalez, of the Normal School, Madrid, has published a noteworthy book on Cyclic Instruction. This has nothing to do with cycling, but simply means the system of teaching by first running lightly over the whole course in a short time, and then recurring to the subjects in detail. This, he maintains, takes away the forbidding character of an unknown subject, and stimulates enquiry for further particulars. Instruction should also be 'concentric' and 'encyclopedic,' *i.e.* it should be grouped round a central object of interest, and should touch every sphere of human cognition.

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THE Central American Educational Congress has met at Guatemala, and formulated an essentially modern programme of primary education. The hours are to be four in the first two years, five during the second two, and six during the last two years. The duration of lessons is to vary from thirty to forty, and fifty minutes, correspondingly. The subjects are to include reading and writing in the national language, national history and outlines of general history, geography of Central America, outlines of geometry, physical and natural science, agriculture, hygiene, moral and social instruction, English language, singing, gymnastics and drill, and manual instruction. The Congress also recommends excursions, vacation colonies, and visits to industrial and agricultural establishments.

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NICARAGUA has adopted a new law rendering primary instruction free and compulsory.

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'FLYING colonies' have been revived at the Hague. Separate parties of boys and girls went for excursions to Scheveningen among the woods and drives. Starting at 9 a.m., each child received a glass of milk. At half-past ten they turned into an inn, and received a glass of milk and a currant loaf each. At noon they returned, winding up the proceedings with another glass of milk. These excursions are supported by voluntary contributions. It is to be hoped that the little Dutch folk enjoyed themselves.

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REGARDING the progress of education among the American Indians, we quote the following from the *Independent*:—

'The report of the Commissioner of Indian Affairs for 1895 gives special attention to questions arising in connection with the education of the Indians. In the first place he shows that there has been an increase of 1,417 in the enrollment, and of 968 in the average attendance of Indian pupils at Government, contract, mission, and public day-schools. The great bulk of this increase is in the Government schools ; indeed, there has been a falling off both in enrollment and attendance at contract schools. These figures do not include the schools among the five civilised tribes of the Indian Territory nor of the Indians in New York, whose schooling is provided for by that State. The Commissioner notes that the older Indians are more favourably disposed toward education, and that the unreasoning opposition to schools, so common in earlier days, has practically disappeared. The Indian recognizes that the old order of things has passed away, and that he must prepare his children to compete with the white children in the struggle of life.'

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VERTICAL writing is making its way in the New World. The *School News* has a special department of vertical writing, conducted by Professor Cavins. In the *American Teacher* Miss Ella Jacobs defends her advocacy of it chiefly on the ground of the child's position:—

'It is one of the best features of vertical penmanship that the child *must* sit straight. True, he *may* be taught to sit straight for slanting writing, but the great majority of school children are certainly trained to sit either with the right or left side to the desk, thus producing a harmful twist to the body, and also injuring the eyes by having one eye brought nearer to the work than the other.'

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THE following laconic statement of the case for vertical writing, embodied in a letter to the editor of the *Australian Schoolmaster* is distinctly effective :—

'SIR,—Mr. Barbour asks what is there in vertical writing. There is great legibility in it ; and as the side of a square—□—is shorter than the diagonal, there is great swiftness in it. Now time is money. Therefore there is money in it ; £ s. d. in it ; pounds, shillings, and pence in it.

'JOSEPH O'MALLEY, S.J.'

Our Science Section.

NOTES ON THEORETICAL MECHANICS.

ADVANCED AND HONOURS STAGES.

BY F. CASTLE, M.I.M.E.

Continued from page 363.

The *screw* consists of a cylinder of metal or wood having a thread (or helix) traced on its surface.

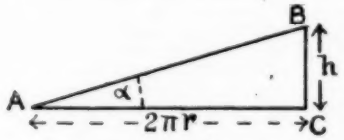
The relation between P and W is easily obtained by the *principle of work*. Thus let R denote the distance from the axis of the screw to the point of application of the force P. When the weight W is raised a distance equal to the pitch h, the point of application of the force P moves through a distance $2\pi R$ (the circumference of a circle whose radius is R). Thus the work done by P is $2\pi RP$, the work expended on W is Wh.

Hence when friction is neglected, we have—

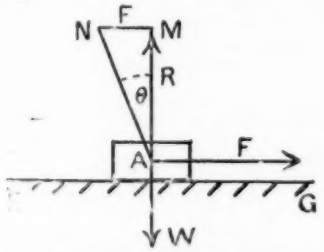
$$2\pi RP = Wh,$$

$$\text{or} \quad \frac{P}{W} = \frac{h}{2\pi R}$$

$$= \frac{\text{vertical distance between two threads}}{\text{circumference of circle described by P}}$$



If we imagine one turn of the screw thread unwrapped from a cylinder of radius r, we shall obtain a right-angled triangle BAC, the height BC being the pitch, the length AC the circumference of a circle of radius r. Let α denote the inclination of the screw thread, then $\tan \alpha = \frac{h}{2\pi r}$.



Friction.—If a body A rests on a horizontal plane EG, and is pressed against it by a force W (where W denotes the weight of the body, together with any additional load or force acting upon it), then, assuming that the surfaces in contact are perfectly smooth, the mutual action between them can only take place along a line AM (the common perpendicular to the two surfaces at the point of contact).

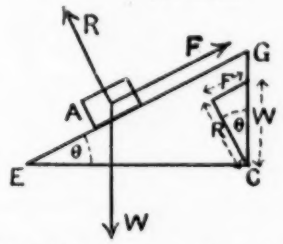
If we suppose the surfaces in contact to be rough, the mutual action will take place along a line inclined at an angle to the common perpendicular. The statical friction will be zero when the mutual action or pressure is normal, and increases with the obliquity of the pressure. When the obliquity reaches a certain value, the body A begins to slide, and at the instant when motion is just about to take place, if θ denote the angle which AN makes with the normal AM, then θ is called the *angle of friction*. Also if the force AN be replaced by its normal and tangential components, AM and NM respectively, the component MN or F attains its maximum or limiting value at the instant referred to, and F is called the *force of friction*.

Thus the work done when the body A is moved through any distance (or space S in feet) would be $F \times S$ ft. pds.

The ratio of NM to AM is called the *coefficient of friction*; denoting this ratio in the usual manner by μ—

$$\text{Then } \frac{NM}{AM} \text{ or } \frac{F}{R} = \mu;$$

$$\therefore F = \mu R.$$



If the plane EG be inclined at an angle to the horizontal plane passing through E, the body A will remain at rest until the inclination of the plane becomes equal to θ, then the body just begins to slide; the relation between F and R can readily be found by drawing the triangle of forces, and starting from any convenient point C, and from the diagram, $\frac{F}{R} = \tan \theta$.

$$\therefore F = R \tan \theta = \mu R,$$

where μ is the tangent of the angle of friction; the angle θ is often called the *angle of repose*.

It should be noted that the friction actually exerted will be the force necessary to prevent sliding, and it is only when sliding either takes place, or is about to take place, that the whole amount expressed by μR is called into existence, friction always acting in a direction opposite to the direction of motion.

The coefficient of *static friction* (or friction between bodies at rest) is slightly greater than the coefficient of *kinetic friction* (or friction between bodies in motion).

The three laws of friction, as they are usually called, were established by Morin, and are :—

(1) Friction is proportional to pressure.

(2) Friction is independent of the area of the surfaces in contact.

(3) Friction is independent of velocity.

These laws are experimental laws, and are only true approximately, and within the limits of the experiments from which they were deduced. In the experiments referred to, the pressures ranged from $\frac{3}{4}$ to 114 or 128 lbs. per square inch, and the velocity did not exceed 10 feet per second.

(*To be continued.*)

MATHEMATICS.

STAGES 2 AND 3, SCIENCE AND ART DEPARTMENT.

BY G. A. BAXANDALL,

Assistant Mathematical Instructor, Royal College of Science, London.

STAGE 2.

Algebra.

Simultaneous Equations involving Quadratics.—The numerous types of such equations at once present a difficulty. The type which most frequently occurs is that in which x and y appear to the first power only in one equation, but to a higher power in the other equation. In such a case the *method of substitution* is adopted. This method will probably, on the whole, serve the student better than any other, and for that reason he must at all times be ready to use it. It is explained in H.K. Art. 207, and in H.S. Art. 250. Another method is one in which the solution is effected by first finding the values of $x + y$ and $x - y$. This is called the *symmetrical method*; it will be found in H.K. Art. 204 or H.S. Art. 251. It is not so general in its application as the method of substitution.

Another type is that in which the equations are said to be *of the same degree and homogeneous*. The solution may then be effected in the manner illustrated in H.K. Art. 206 or H.S. Art. 258.

Suppose we have the equation $4x^2 - 7xy + 3y^2 = 0$; it may be written $4\left(\frac{x}{y}\right)^2 - 7\left(\frac{x}{y}\right) + 3 = 0$, which is a quadratic for $\frac{x}{y}$. Now suppose that we have to solve the simultaneous equations $x^2 + y^2 = 5$ and $2xy - y^2 = 3$, then the following method may be used instead of the one explained in the arts. just mentioned:—

$$3x^2 - y^2 = 23. \quad (1)$$
$$2x^2 - xy = 12. \quad (2)$$

Multiply (1) by 12 and (2) by 23 and subtract, the object being to get an equation with zero on the right. Thus we get—

$$36x^2 - 12y^2 = 276$$
$$46x^2 - 23xy = 276$$
$$10x^2 - 23xy + 12y^2 = 0$$
$$10\left(\frac{x}{y}\right)^2 - 23\left(\frac{x}{y}\right) + 12 = 0$$
$$\left(5\frac{x}{y} - 4\right)\left(2\frac{x}{y} - 3\right) = 0.$$
$$\therefore \frac{x}{y} = \frac{4}{5} \text{ or } \frac{3}{2}; \quad \therefore x = \frac{4}{5}y \text{ or } \frac{3}{2}y. \quad (3)$$

Substitute these values of x in (1) in turn; and obtain $y = \pm 5$, ± 2, which on being substituted in (3) give $x = \pm 4$, ± 3.

There are other types of simultaneous equations which require treating by more special methods, and success in working these is only acquired after a great amount of practice. We would repeat that the method of substitution should be kept uppermost in the mind of the student while working at simultaneous equations involving quadratics.

Read Art. 205, H.K., or Art. 256, H.S.

Work examples from each of the sets in Chap. XXVI., H.K., or Chap. XX., H.S.

11. Solve the following equations by the method of substitution:—

(1) $xy + y = 12$, $y + 3 = 2x$ (2) $x - y = \frac{2}{3}(x + y)$, $x^2 + xy = 270$

(3) $6y^2 - 3x^2 - 5xy = 48$, $15x^2 - 19xy + 6y^2 = 0$

Ans. (1) $x = 3, -\frac{8}{3}$; $y = 3, -8$.

(2) $x = \pm 15$; $y = \pm 3$.

(3) $x = \pm 3, \pm 4$; $y = \pm 5, \pm 6$.

12. Solve the following equations by the method of symmetry:—

(1) $x^2 - 3xy + y^2 = 5$, $xy = 4$ (2) $16x^2 - 12xy + 9y^2 = 144$, $xy = 12$

(3) $9x^2 - 25y^2 = 44$, $3x + 5y = 22$ (4) $xy^2 = 18$, $x^2y = 12$

(5) $2x + 3y = 19$, $xy = 15$ (6) $x^2 - xy + y^2 = 15\frac{1}{16}$, $x - y = 3\frac{3}{4}$

Ans. (1) $x = \pm 1, \pm 4$; $y = \pm 4, \pm 1$.

(2) $x = \pm 3$; $y = \pm 4$. (3) $x = 4$; $y = 2$.

(4) $x = 2$; $y = 3$. (5) $x = 4\frac{1}{2}, 5$; $y = 3\frac{1}{3}, 3$.

(6) $x = 4, -\frac{1}{4}$; $y = \frac{1}{4}, -4$.

Trigonometry.

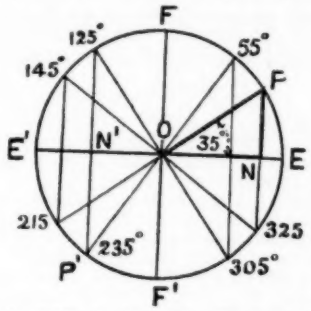
Ex. 16 (*January*).—Since BAC = 120°, then ECA = 30°, and hence ADE = 15°. Now if AE = 1, then EC = $\sqrt{3}$, and AC = 2 = CD; therefore ED = $2 + \sqrt{3}$.

$$AD = \sqrt{1^2 + (2+\sqrt{3})^2} = \sqrt{8 + 4\sqrt{3}} = \sqrt{2(4 + 2\sqrt{3}}$$
$$= (\sqrt{3}+1)\sqrt{2}.$$
$$\tan 15° = \frac{AE}{ED} = \frac{1}{2+\sqrt{3}} = \frac{2-\sqrt{3}}{(2+\sqrt{3})(2-\sqrt{3})}$$
$$= 2 - \sqrt{3}.$$
$$\sin 75° = \frac{AE}{AD} = \frac{1}{\sqrt{2}(\sqrt{3}+1)}$$
$$= \frac{\sqrt{3}-1}{\sqrt{2}(\sqrt{3}+1)(\sqrt{3}-1)}$$
$$= \frac{\sqrt{3}-1}{2\sqrt{2}}.$$

Similarly cos 15° may be shown to be $\frac{\sqrt{3}+1}{2\sqrt{2}}$.

The definitions of the trigonometrical ratios of an angle greater than a right angle have already been given, and also the method of obtaining the numerical values of these ratios for certain special angles. Arts. 98 to 105, H.S., *or* Arts. 117, 118, 140, 141, "Lock," may now be read, but we would advise the student not to commit any of the results in these articles to memory; should any one of these results be required it must be determined by appealing to a carefully drawn figure. We will now ask the reader to take a general view of the portion of the subject involved in the above articles.

Let a circle be described, and two diameters, E'E, FF', be drawn at right angles to each other. Let a radius start from OE and turn



until the angle POE is described. To fix our ideas, suppose POE = 35°; draw PN at right angles to OE. Then it is evident that if the radius OP continue to make a complete rotation it will several times occupy a position such that if a perpendicular be drawn from P to OE or OE', a right-angled triangle equal in all respects to PON will be formed. The angles corresponding to these positions will be, in order, (90° − 35°), (90° + 35°), (180° − 35°), (180° + 35°), (270° − 35°) (270° + 35°), (360° − 35°). Now, if we wish to obtain the value of any trigonometrical ratio of any of these angles, we shall have to consider a right-angled triangle equal in all respects to PON, where the angle PON = 35°. Hence it is evident that for all these angles the trigonometrical ratios are related to those of 35°. Consider, say, the angle 270° − 35°, that is 235°.

$$\sin 235° = \frac{P'N'}{OP'} = \frac{-ON}{OP} = -\frac{ON}{OP} = -\cos 35°,$$
$$\cos 235° = \frac{ON'}{OP'} = \frac{-PN}{OP} = -\frac{PN}{OP} = -\sin 35°,$$
$$\tan 235° = \frac{P'N'}{ON'} = \frac{-ON}{-PN} = \frac{ON}{PN} = \cot 35°,$$

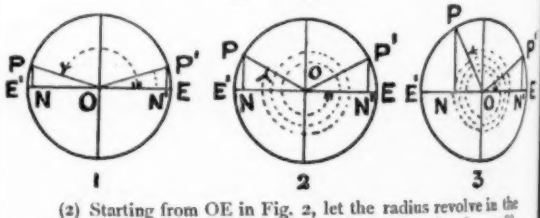
and so on. It will be observed that in the first of the three last lines it would be wrong to put + ON after P'N', for ON and P'N', although equal in length, are opposite in *sign*. The main difficulty consists of attaching the proper signs.

Example.—Express sin 168°, cos − 928°, tan 1,195° in terms of the ratios of a positive angle less than 45°.

Solution—

(1) Draw a figure similar to Fig. 1, in which EOP = 168°, and therefore E'OP = 12°. Make EOP' = 12°, then

$$\sin 168° = \frac{PN}{OP} = \frac{P'N'}{OP'} = \sin 12°.$$



(2) Starting from OE in Fig. 2, let the radius revolve in the *negative* direction until it has described an angle of −925°, that is, twice round and 208° more, finally arriving at OP. The angle E'OP = 28°; make EOP' = 28°, then

$$\cos -928° = \cos EOP = \frac{ON}{OP} = \frac{-ON'}{OP'} = -\frac{ON'}{OP'}$$
$$= -\cos 28°.$$

(3) Let the radius starting from OE, Fig. 3, make *three* revolutions in the positive direction, and 65° more, that is 1,195° in all, finally arriving at OP, then E'OP = 65° and NPO = 25°. Draw OP' perpendicular to OP, then the triangle OP'N' is equal to the triangle OPN, and

$$\tan 1{,}195° = \frac{PN}{ON} = \frac{ON'}{-P'N'} = -\frac{ON'}{P'N'} = -\cot 25°.$$

Work Exs. XXII. H.S., or Exs. XXVIII. and XXX., Lock, and the following :—

18. Draw clear figures indicating angles of $-65°$, $-84°$, $137°$, $287°$, $-246°$, $843°$, $1,410°$, $-1,054°$, $1,327°$ and $-756°$. Express the following ratios in terms of the ratios of a positive angle less than 45° ; sin $(-65°)$, cos $(-84°)$, tan $137°$, cos $287°$, tan $(-246°)$, sin $843°$, cos $1,410°$, cot $(-1,054°)$, sec $1,327°$, and cosec $(-756°)$.

Ans. $-\cos 25°$, $\sin 6°$, $-\tan 43°$, $\sin 17°$, $-\cot 24°$, $\cos 33°$, $\cos 30°$, $\cot 26°$, $-\operatorname{cosec} 23°$, $\operatorname{cosec} 36°$.

19. What *sign* has sin A + cos A for the following values of A?

$$-457°,\ 215°,\ \frac{11\pi}{3},\ 855°,\ -510°,\ 960°,$$

and obtain the numerical value of sin A + cos A for the last four angles.

Ans. —, —, $-\frac{\sqrt{3}-1}{2}$, 0, $-\frac{\sqrt{3}+1}{2}$, $-\frac{\sqrt{3}+1}{2}$.

20. What values between 0° and 360° may θ have when (1) $\cos\theta = -\frac{1}{2}$, (2) $\operatorname{cosec}\theta = -2$, (3) $\tan\theta = -1$?

Ans. (1) 120°, 240° ; (2) 210°, 330° ; (3) 135°, 315°.

21. Given $\tan A = 1{\cdot}05$ and $\cos B = {\cdot}28$, find sec A and cosec B.

Ans. $\frac{\sqrt{841}}{20}$; $\frac{25}{24}$.

(*To be continued.*)

ORGANIC CHEMISTRY NOTES.

BY J. T. HEWITT, M.A., D.SC., PH.D.,

Professor of Chemistry, People's Palace Technical Schools.

We shall now have to deal with a number of alkaloïds, which, in addition to carbon, hydrogen, and nitrogen, contain oxygen as a constituent. A large number of such compounds occur in Nature, and we can here only refer to the more important.

The constituents of the root of *Aconitum napellus* have been examined by various chemists, and Geiger and Hesse obtained a crystalline alkaloïd to which they gave the name of aconitine. This was afterwards examined at considerable length by Wright and Luff, who assigned to it the formula $C_{33}H_{43}NO_{12}$ (see *Jour. of Chem. Soc.*, 1877. 143 ; 1878. 151, 318 ; 1879. 387). At the same time these chemists took in hand the examination of various products which are formed by the breaking down of aconitine, and so obtained apoaconitine by splitting off of water (hence apoaconitine was given the formula $C_{33}H_{41}NO_{11}$), whilst they found that when aconitine is heated with water to 140°, that it is hydrolysed, giving benzoic acid and an amorphous base, aconine, $C_{28}H_{37}NO_{11}$.

Ehrenberg and Purfürst, in 1892, observed acetic acid amongst the splitting products of aconitine, and the constitution of this base has now been made the subject of further investigations by Wyndham Dunstan and his pupils in this country, and by Freund and Beck in Berlin. Dunstan, in consequence of his analytical results, gave aconitine the formula $C_{35}H_{45}NO_{12}$ instead of the formula $C_{33}H_{43}NO_{12}$ originally proposed by Wright and Luff. Ehrenberg and Purfürst stated that aconitine on hydrolysis, first loses benzoic acid, giving picraconitine, that this in turn loses methylalcohol forming napelline, and that finally, by loss of acetic acid, aconine results. Dunstan and Freund have both come to the conclusion that acetic acid is the first group to be split out of the molecule, and that picraconitine results in this way, whilst on further hydrolysis a benzoyl group is split off, and the base aconine results. Although agreed on this point, the analytical results obtained by these two chemists do not agree, and whereas Dunstan gives the following formulæ to the alkaloïd and its breaking down products—

Aconitine - - -	$C_{33}H_{45}NO_{12}$,
Picraconitine - - -	$C_{31}H_{43}NO_{11}$,
Aconine - - -	$C_{24}H_{39}NO_{10}$,

Freund gives to these three bases the following formulæ—

Aconitine - - -	$C_{34}H_{47}NO_{11}$,
Picraconitine - - -	$C_{32}H_{45}NO_{10}$,
Aconine - - -	$C_{23}H_{41}NO_9$.

Since the discussion can hardly be considered to be at an end, we can only state that aconitine is agreed by both experimenters to be acetylbenzoylaconine, and refer for the points of the discussion to their original papers, Ehrenberg and Purfürst, *Jour. f. Prakt. Chemie.* 45. 604.

Dunstan, *Jour. Chem. Soc.* 57. 271 ; 61. 393, 395, 443 ; 63. 443, 491, 991, 994 ; 65. 174, 176, 290 ; 67. 459. *Ber.* 27. 664 ; 28. 1379.

Freund, *Ber.* 27. 433, 720 ; 28. 192, 2537.

Atropine, Hyoscyamine and Hyoscine, are three isomeric alkaloïds of the formula $C_{17}H_{23}NO_3$, they resemble one another closely, and are probably stereo-isomers.

Atropine occurs in all parts of the deadly nightshade—*Atropa belladonna*. It is extracted from this plant by pressing out its juice just before the flowering time, raising the liquid to 89°–90°, and shaking every litre of the filtrate with 4 grams of potash and 30 grams of chloroform. The chloroform is then distilled off, and the atropine extracted from the residue by dilute sulphuric acid, from which solution it is precipitated by potassium carbonate, and recrystallized from alcohol. Instead of this process, the atropine may be extracted from the officinal belladonna extract.

Atropine was produced by Ladenburg (*Ann.* 217. 78) by heating tropine tropate, $C_8H_{15}NO.C_9H_{10}O_3$, with hydrochloric acid on the water-bath. It was also obtained by Will (*Ber.* 21. 1719) by heating hyoscyamine for 5 hours to 110°, or by allowing its alcoholic solution, to which a little soda had been added, to stand for several hours.

The alkaloïd gives the following reactions :—A violet coloration which soon passes into red is obtained, by evaporating its solution in fuming nitric acid to dryness on the water-bath, and then covering the residue with a drop of alcoholic potash. On adding an aqueous solution of mercuric chloride to an alcoholic solution of atropine, a yellow precipitate is obtained, which, on boiling, becomes red from separation of mercuric oxide.

Atropine crystallizes in needles, which melt at 115°, its slight optical activity ($[\alpha]_D = -1.89°$) is said by Ladenburg to depend on impurities.

When atropine is hydrolysed by baryta or hydrochloric acid it splits up into tropine, $C_8H_{15}NO_1$, and tropic acid, $C_9H_{10}O_3$. According to Ladenburg, tropine is α-oxyethyl-n-methyl-tetrahydropyridine, $CH_3.N : C_5H_7.CH_2.CH_2.OH$. This compound was, however, synthesised by Lipp in 1892 (*Ber.* 25. 2197), and found to be quite distinct from tropine. Another explanation of the constitution of tropine has been given by Merling (*Ber.* 24. 3108). Ladenburg's formula was based principally on the following series of reactions. When atropine or tropine is heated with fuming hydrochloric acid and acetic acid to 180°, or is heated with sulphuric acid, the tropine loses a molecule of water, and is converted into a base called tropidine according to the equation—

$$C_8H_{15}NO = C_8H_{13}N + H_2O.$$

On the other hand, if tropine (4 grams) is heated with fuming hydriodic acid (14 grams) and phosphorus (1 gram) to 140°, a compound know as tropidine iodide, $C_8H_{15}NI_2$, is produced, which is found to give up only one iodine atom for replacement by chlorine when treated with silver chloride. On the other hand, if boiled with silver nitrate, both of the iodine atoms are eliminated, and a salt of a base, $C_8H_{17}NO$, is produced. When tropidine iodide is reduced by a mixture of hydrochloric acid and zinc dust, hydrotropidine, $C_8H_{15}N$, results ; this base is described by Ladenburg as a liquid boiling at 167°–169°, and having a specific gravity of ·9336 at 0°.

From the hydrotropidine Ladenburg obtained a strong base, norhydrotropidine, $C_7H_{13}N$, by heating the hydrochloride in a stream of hydrogen chloride ; the decomposition following the equation—

$$C_8H_{16}N + HCl = C_7H_{13}N + CH_3Cl.$$

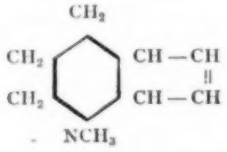
If the hydrochloride of this latter base is heated to redness with zinc dust, it loses 4 atoms of hydrogen, and α-ethyl pyridine results.

Considering the following possible formulæ, we see how Ladenburg was led to regard tropine as α-oxyethyl-n-methyl-tetrahydropyridine. (In this table, a compound is always obtained from the one next below it.)

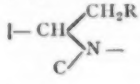
α-ethyl pyridine -	$CH_3.CH_2.C_5H_3 : NH$.
Norhydrotropidine -	$CH_3.CH_2.C_5H_7 : NH$.
Hydrotropidine -	$CH_3.CH_2.C_5H_7 : N(CH_3)$.
Tropidine iodide -	$I.CH_2.CH_2.C_5H_7 : N(CH_3)HI$.
Tropine - -	$HO.CH_2.CH_2.C_5H_7 : N(CH_3)$

As already stated, some of Merling's experimental results do not agree with this view of the constitution of tropine, and Lipp's synthesis of oxyethyl-n-methyltetrahydropyridine, a compound distinct from tropine, shows that Ladenburg's conclusion as to the structure of this splitting product of atropine must be wrong.

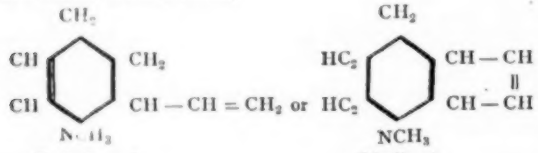
Some time ago (*Annalen*, 216. 348) Merling showed that when tropine is oxidised with chromic acid, a dibasic tropinic acid, $C_6H_{11}N(COOH)_2$, results, and such a compound cannot be very well conceived as resulting without there being two side chains in the tropine molecule. That ethyl pyridine can be prepared from tropine is indubitable, and to reconcile these facts Merling proposed for tropidine the formula—



This he afterwards altered (*Ber.* 24. 3108) on account of the following reactions:—α-Methyltropidine combines with hydrochloric acid to give a hydrochloride, which unites with still another molecule of hydrochloric acid to give the salt of hydrochlor-α-methyltropidine. The free base, $C_7H_{10}Cl\,N(CH_3)_2$, when heated on the water-bath, gives an isomer, which is tropidine-methylammonium chloride $(C_7H_{10})''N(CH_3)_2Cl$, and this ammonium chloride decomposes on distillation into methyl chloride and tropidine. From a consideration of analogous cases, Merling concludes that tropidine contains the atom-grouping—



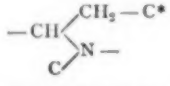
whilst neither of the formulæ,



(Ladenburg.) (Merling.)

will explain such behaviour.

Ladenburg's conversion of norhydrotropidine into ethyl pyridine shows, however, that the above atom-grouping must be developed to—



and since tropidine gives on oxidation the dibasic tropinic acid, the second carbon atom (C*) of the side chain must also be attached to the pyridine ring.

Again, α-methyltropidine unites with methyl iodide to an ammonium iodide—

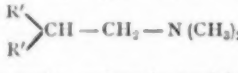
$$\left.\begin{matrix}C_7H_9\\(CH_3)_3\end{matrix}\right\}NI,$$

which gives a hydroxide—

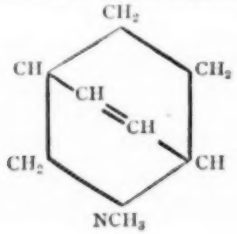
$$\left.\begin{matrix}C_7H_9\\(CH_3)_3\end{matrix}\right\}NOH,$$

with silver oxide. This compound breaks up when its aqueous solution is distilled into trimethylamine, water, and a hydrocarbon tropilidene, C_7H_8.

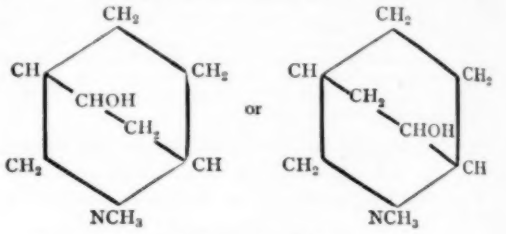
We thus have in α-methyltropidine the atomic grouping—



Combining these results, we have for tropidine the formula—

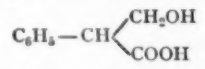


which leaves for tropine one of the two formulæ—

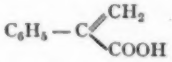


Of these, the former is the most probable.

Turning now to the other splitting product of atropine, tropic acid, $C_9H_{10}O_3$, we assign to it the constitution—



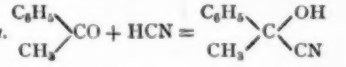
By long boiling with baryta, this compound loses a molecule of water and passes into the compound $C_9H_8O_2$, atropic acid, of the constitution—



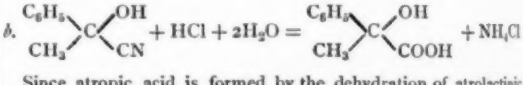
It is also formed by the splitting off of water from the atrolactinic acid, an isomer of tropic acid.

Atrolactinic acid may be synthesised by treating the cyanhydrin of acetophenone with cold fuming hydrochloric acid (Spiegel, *Ber.* 14. 1353).

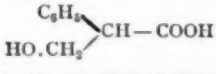
a.



b.



Since atropic acid is formed by the dehydration of atrolactinic acid, it must have the constitution of a phenylacrylic acid, which we have assigned to it; and, further, since atropic acid is also formed by the splitting off of water from tropic acid, the latter can only be written with the formula—



Hyoscyamine, $C_{17}H_{23}NO_3$, the alkaloïd of henbane (*Hyoscyamus*), is an isomer of atropine. When it is hydrolysed by baryta or hydrochloric acid, it gives tropine and tropic acid, though in this case both the products appear to be lævorotatory. As before mentioned, hyoscyamine may be converted into atropine by alcoholic potash, and hence the two alkaloïds are to be looked on as stereo-isomers.

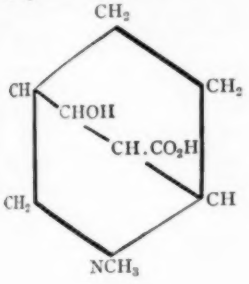
Hyoscine, another isomeric alkaloïd, which is found with hyoscyamine in henbane, is probably a third stereo-isomer.

Cocaïne, $C_{17}H_{21}NO_4$, the well-known alkaloïd of *Erythroxylon coca*, must be taken here, since it is closely connected with the tropine compounds. To prepare it, coca leaves are extracted with water at 60°–80°, the solution precipitated by lead acetate, and the excess of lead removed from the filtrate by the addition of sodium sulphate. Soda is then added until the solution is feebly alkaline, the base then extracted with ether, and combined with hydrochloric acid. The hydrochlorate is purified by dialysis, and the free base finally recrystallized from alcohol. The base melts at 98°, is slightly soluble in water, and rotates the plane of polarised light to the left.

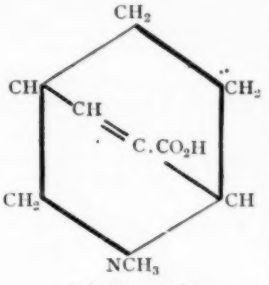
When hydrolysed by hydrochloric acid, the alkaloïd breaks up into benzoic acid, methyl alcohol, and ecgonine, $C_9H_{15}NO_3$. Conversely ecgonine may be converted into its benzoyl derivative by adding one molecular quantity of benzoic anhydride to a hot solution of two parts of ecgonine in one part of water, and digesting for one hour; and this benzoylecgonine may then be transformed into cocaïne by heating with sodium methylate and methyl iodide at 100°.

Ecgonine, $C_9H_{15}NO_3$, is a carboxylic acid of tropine, since anhydroecgonine, $C_9H_{13}NO_2$, has been proved by Einhorn to be a car-

boxylic acid of tropidine. Hence Merling represented these two compounds by the formulæ—

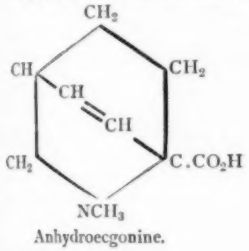


Ecgonine.

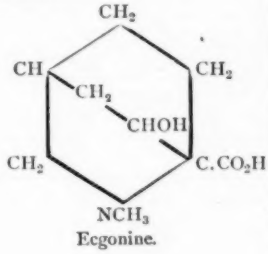


Anhydroecgonine.

These two formulæ have since been altered by Einhorn (*Ber.* 26, 324, 451, 862) to the nearly related ones—

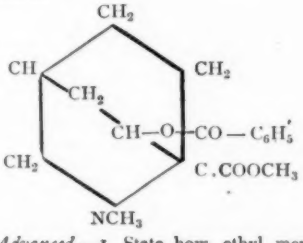


Anhydroecgonine.



Ecgonine.

And cocaïne will be—



Questions.—Advanced.—1. State how ethyl mercaptan, ethyl sulphide, ethyl disulphide, triethyl sulphonium iodide, and ethyl-sulphonic acid may be prepared. 2. Classify the chief methods of formation of ketones and aldehydes. 3. Give the equations for the preparation of allyl iodide, acrolein, and acrylic acid. 4. Describe the various methods which have been used for preparing aromatic ketones.

Honours.—Do Advanced Questions—1. Point out the results arrived at by Ladenburg and Merling with regard to the constitution of tropine. 2. What reasons have we for considering that atropine and hyoscyamine are stereo-isomeric? 3. How may ecgonine be converted into cocaïne?

SCIENCE NOTES.

CULTIVATION OF CHICORY IN ENGLAND.—Some very interesting particulars respecting the chicory industry in England were recently given to the Chemical Industrial Society by Dr. Shack Sommer. The cultivation of this plant spread rapidly after its introduction in 1820, and it used to be one of the regular crops in Essex, Norfolk, Lincolnshire, and Yorkshire; but of late years its cultivation has rapidly declined, apparently in consequence of the onerous duties imposed by the Inland Revenue Department upon the grower with the idea of protecting the revenue. The imports for the past year of chicory, as shown by the Board of Trade returns, were 5,466 tons, four-fifths of which were entered for home consumption, the home-grown chicory for the year only reaching 117 tons, all grown in the one county of York, whilst the quantity grown in 1867 amounted to over a thousand tons.

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THE INDUSTRIAL USE OF THE POTATO.—Another interesting suggestion is also made by Dr. Sommer. He is of opinion that the potato crop might be used in England as raw material for the industrial preparation of starch, glucose, and potato spirit. It is a strange fact that though the yield per acre of potatoes is greater in Great Britain than in any other European country, we not only do not grow a sufficient quantity for the supply actually demanded for human food, but also the acreage under cultivation is steadily diminishing. The fact that the annual quantity of this vegetable employed in France in the manufacture of starch and alcohol reaches some four million tons, may serve to give some idea of the importance to which the cultivation of the potato for industrial use, if properly developed, might attain to in this country. Dr. Sommer is of opinion that if factories were established in our more remote agricultural districts, potatoes grown within a reasonable radius would be able to compete favourably with imported rice and maize, the raw materials at present in use, whilst a lasting benefit would be conferred on the adjacent agricultural population. The product of starch from the potato is a particularly simple one, and from the starch so prepared glucose is obtained by the action upon it of dilute sulphuric acid. The quantity and value of glucose imported into the United Kingdom during the past year, as given in the Board of Trade returns, was 1,062,074 cwts., valued at £542,195. The number of proof gallons of plain foreign spirit which paid duty on coming into the United Kingdom during the same year was 1,176,118 gallons, all of which, it may safely be assumed, was distilled from potatoes.

***

THE DISCOVERY OF NICKEL CARBONYL.—In the course of some experiments on the recovery of the chlorine usually lost in the ammonia soda process, Mr. Ludwig Mond, who was attacking the problem by directly splitting up ammonium chloride, found that nickel was one of the few substances which were not attacked by the vapour of ammonium chloride. He discovered, however, that though nickel answered perfectly on a laboratory scale, when practically employing it for valves for changing the current the faces of the valves became covered with a thick crust, which on examination was found to contain carbon. On tracing this to its source, it was found to arise from the presence of some carbonic oxide in the kiln-gases used to sweep the ammonia out of the apparatus. Mr. Mond was thus led to investigate the action of nickel on carbonic oxide, from which resulted the discovery of nickel carbonyl, a gaseous compound of nickel and carbonic oxide, a body which Mr. Mond claims to be 'without any parallel in the history of chemistry.' The production of this gas was soon made the basis of a commercial method for the extraction of nickel from its ore, and the process is now successfully at work near Birmingham, the present output being at the rate of a ton and a half of nickel per work extracted from Canadian nickel copper matter.

***

ORIGIN OF ATMOSPHERIC OXYGEN.—In a recent communication to the Paris Academy of Sciences, Mr. T. L. Phipson summarises the results of his speculations on the origin of atmospheric oxygen. He is of opinion that the earth's atmosphere originally consisted of nitrogen only, and that the carbon dioxide in the air, water, and earth was subsequently furnished by the action of volcanoes. Primitive plants, being essentially anærobic, thrived in this atmosphere of nitrogen, carbon dioxide, and water, and free oxygen was the product of their activity in decomposing the carbon dioxide. The author finally arrives at the following conclusions:—(1) That in the earliest periods, as at present, nitrogen constituted the greater portion of the earth's atmosphere; (2) that the presence of free oxygen in the air is entirely due to the action of vegetation; (3) that existing plants, like their primitive progenitors, are essentially anærobic; (4) that the proportion of free oxygen in the air has been gradually augmented in the course of ages, the anærobic organisms meanwhile adapting themselves at first to a more or less anærobic state of existence, as in the case of fungi ferments, bacteria, etc., and later completely anærobic (animal) forms have appeared; (5) that even now the lowest unicellular algæ give out weight for weight more oxygen than the superior plants; (6) that in proportion as the relative quantity of oxygen in the air has been augmented in the course of ages, the cerebro-spinal nervous system, the highest characteristic of animal life, has become more and more developed.

***

THE ELECTRIC LIGHT AND VEGETATION.—We have more than once directed attention in these columns to the interesting connection existing between the electric light and the processes of vegetation. M. G. Bonnet, in a recent number of the *Révue Générale de Botanique*, states as the results of a series of experiments carried out by him that a continuous electric light promotes the formation of chlorophyll in plants, and induces at the same time a simpler anatomical structure of the leaves. He finds that the distribution of the chlorophyll in the tissues is more general under a continuous

electric light than in ordinary daylight ; and that chlorophyll corpuscles make their appearance in the cortex as far as the endoderm, and even in the medullary rays and pith. The palisade tissue of the leaf is reduced in amount, or disappears entirely, and the epidermal cell-walls become thinner. The bark is less developed, and the various tissues of the stem are less differentiated. When the electric light is discontinuous, being employed for instance twelve hours out of the twenty-four, the effect on vegetation is, as we should expect, intermediate between that of normal light and that of continuous electric light. When Alpine plants are cultivated under a continuous electric light, they exhibit characters identical with those of arctic plants which are exposed during the summer to almost continuous daylight. It is interesting in this connection to notice that according to the results obtained by Professor Aloi both atmospheric and terrestrial electricity exercise a favourable influence on the germination of seeds, and on the growth of plants, as is shown by their quicker germination, and by their yielding a greater weight of produce in the same time. The application of electricity bids fair to be one of the most important new appliances in the scientific agriculture of the future.

***

SOLUBLE FERMENTS AND ALCOHOL.—In the course of some recent experiments, A. Dastre has shown that soluble ferments are not, as has hitherto been supposed, wholly insoluble in alcohol. Although the digestive ferments and those of blood, taken in the dry state, are totally insoluble in strong alcohol, it is otherwise when the alcohol is mixed with water. Then trypsin is found to be very soluble in alcoholic liquors of the strength of from ten to twenty-five per cent., but less so in fifty per cent. and stronger solutions. The amylotic ferment is even more soluble, dissolving as it does in sixty-five per cent. alcohol. The ferments of blood are only slightly soluble, and not at all so in solutions containing more than four or five per cent. of alcohol. M. Dastre gives the scale of solubility as follows :—Diastasic and proteolytic ferments of the blood, emulsin, ptyalin, trypsin, pepsin, ferment of gaulterin, amylotic ferment of the pancreas, and myrosin.

PUBLICATIONS RECEIVED DURING JANUARY.

GEO. BELL & SON.

Bell's Combination Test Cards. Standards 1 to 7.
Animal Life Readers: The Animals on Strike, History of the Robins and Keeper's Travels, Man's Helpers, From Many Lands. (Edith Carrington.)

BLACKIE & SON, LIMITED.

Cæsar's Gallic War. Book V. (Brown.)
French Tales for Beginners. (Ninet.)
The Warwick Shakespeare : Henry V. (Moore Smith.)
Transcription Exercises. Standards 1 to 4.
School and Home Library: The Wreck of the 'Wager.'

CASSELL & CO., LIMITED.

Cassell's New Geographical Readers. Seventh Book.

W. B. CLIVE & CO.

The Tutorial French Grammar. (Weekly and Wyatt.)

CURWEN & SON.

The Musical Herald (January).

THE 'GRAPHIC' OFFICE.

The Golden Penny Volume, June to December 1895.

A. M. HOLDEN.

The New Drawing Cards. In Colours. (Jackson.)
The New Drawing Cards for Infants. In Colours (Jackson.)

JARROLD & SONS.

The Day-by-Day Arithmetic. Parts 1, 2, and 3. (Ellery.).
Suitable Occupation Designs for Colouring Sets A and B K. G. Designs.
The Day by Day Arithmetical Test Cards, Standard 6 (Ellery).

MACMILLAN & CO.

Varied Occupations in String Work. (Louisa Walker.)
The Civil Service Reader. (Evan Jacob.)
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Macmillan's 'Official' Copy Books. Nos. 1 to 12.

OXFORD SHORTHAND CO.

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SONNENSCHEIN & CO. LIMITED.

Failure and Success. (E. Allenshaw.)

R. WADDINGTON.

Drawing to Scale. Standard 4: Scholars' Own Drawing Book, and Key to ditto.

REVIEWS.

Macmillan's New Literary Readers. Book III. London: Macmillan & Co.

Like the other books of the series, this is marked by much variety and matter, and makes good its claim to be called a *Literary* Reader. The greater part consists of extracts from the works of such well-known authors as Kingsley, Hawthorne, Mrs. Molesworth, Lady Barker, and Mrs. Craik. From the latter we have a very interesting series of descriptive chapters on the months. The selection of poems is particularly good. Such a book is likely to interest the little folk, and to give them a taste for reading. It forms a very decided contrast to the books that used to be compiled for children, with the notion apparently that any loose or imperfect style of composition was good enough for a Third Standard reading book.

The binding and general get-up are equally deserving of commendation with the contents.

Royal Science Readers. Book I. London: T. Nelson & Sons.

Produced with all the material excellences of paper, type, illustration, and binding which distinguish the best books in the Royal School Series, this first volume of a new set of readers will prove a capital companion to the object-lessons now required to be given in the lower Standards. The subjects, 30 in number, are well varied, including animals, plants, minerals, and some natural phenomena. The facts are sensibly chosen, and presented in a simple and interesting fashion. Summaries of the lessons and lists of the more difficult words are given at the end of the book, and a suitable collection of easy poems bearing on some of the subjects forms a sort of supplement.

We cordially commend the book to the attention of teachers.

French Tales for Beginners. By Marguerite Ninet. London: Blackie & Son.

Children who have made but little progress in learning French would soon find Mademoiselle Ninet's simple stories pleasant and attractive. There are 13 subjects, and they are divided into about twice that number of lessons. Each lesson is preceded by a list of the words it includes with their English equivalents, and followed by any new expressions likely to prove difficult. These of course are translated. As the author says, 'the stories are not new ; they are old friends in a new garb,' and we may add the new garb admirably fits them. Several are old fables or stories of the time when birds and beasts could talk, and some are well-told anecdotes.

A full vocabulary, alphabetically arranged and placed at the end of the book, renders the young readers independent of the help of a dictionary.

The Royal Coloured Kindergarten Drawing Cards, Set I. Royal Kindergarden Blank Drawing Book. London: Thomas Nelson & Sons.

Twenty-eight stiff cards ruled with squares bear designs formed in every case by straight lines. These designs are coloured as patterns for the pupils. They include easy geometrical patterns suitable for tiles, capital letters and common objects, such as a panelled door, a slate, a T-square. The designs are very varied, and the colouring is in most

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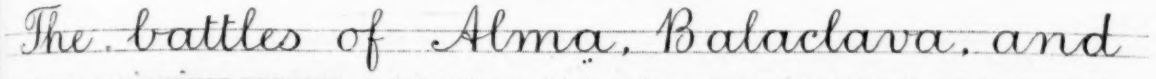

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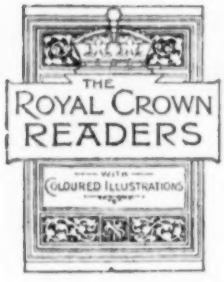

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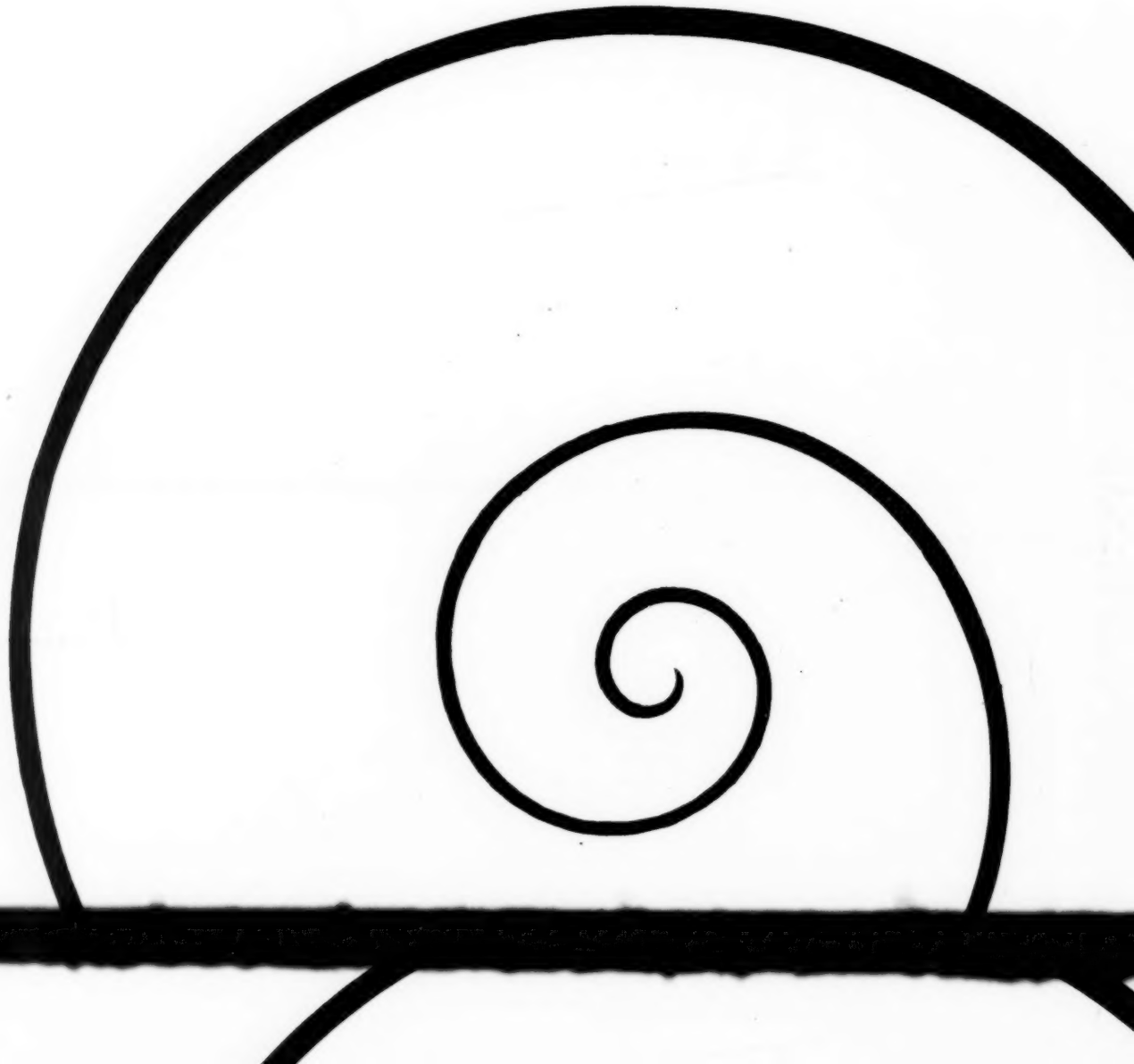

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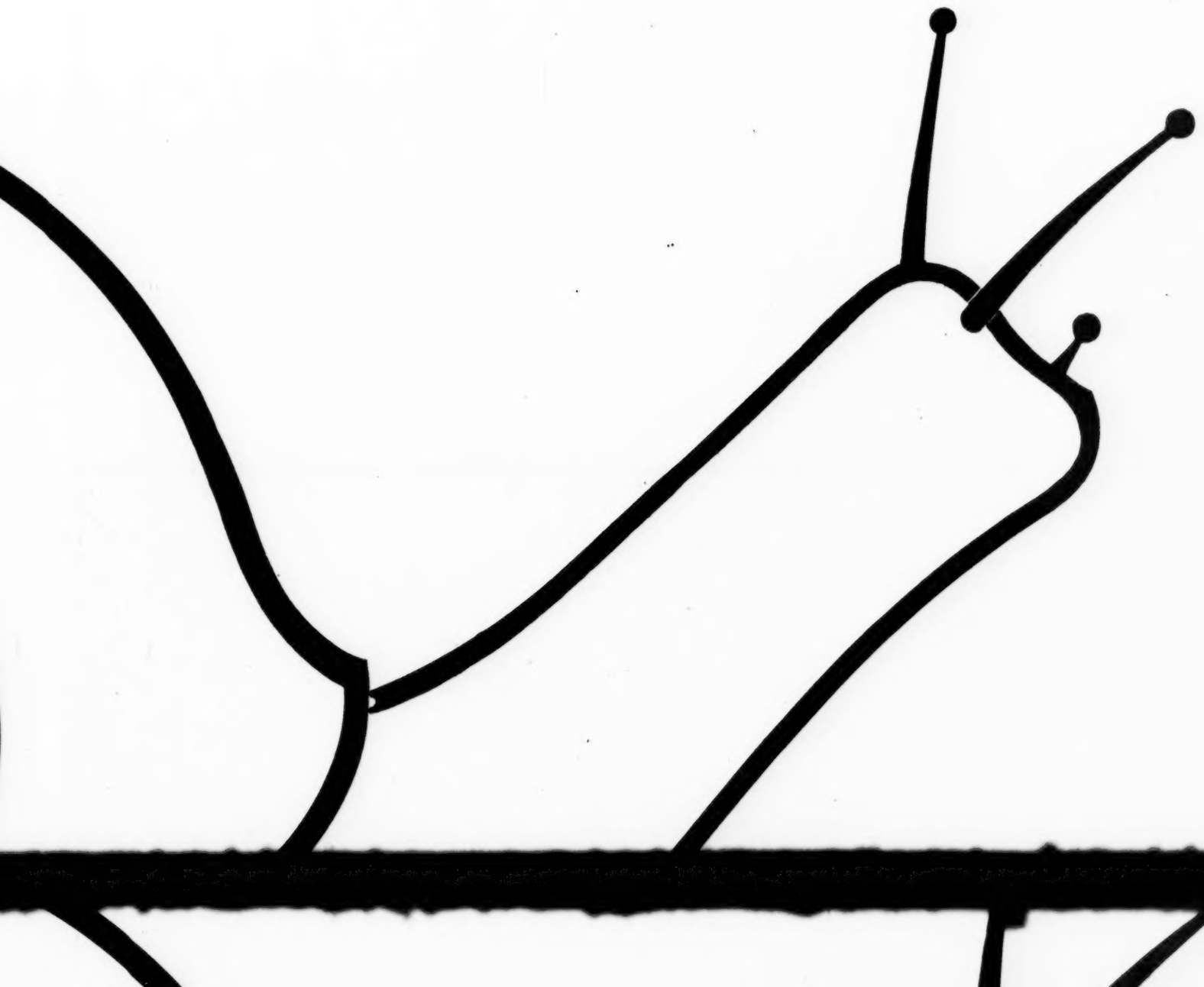

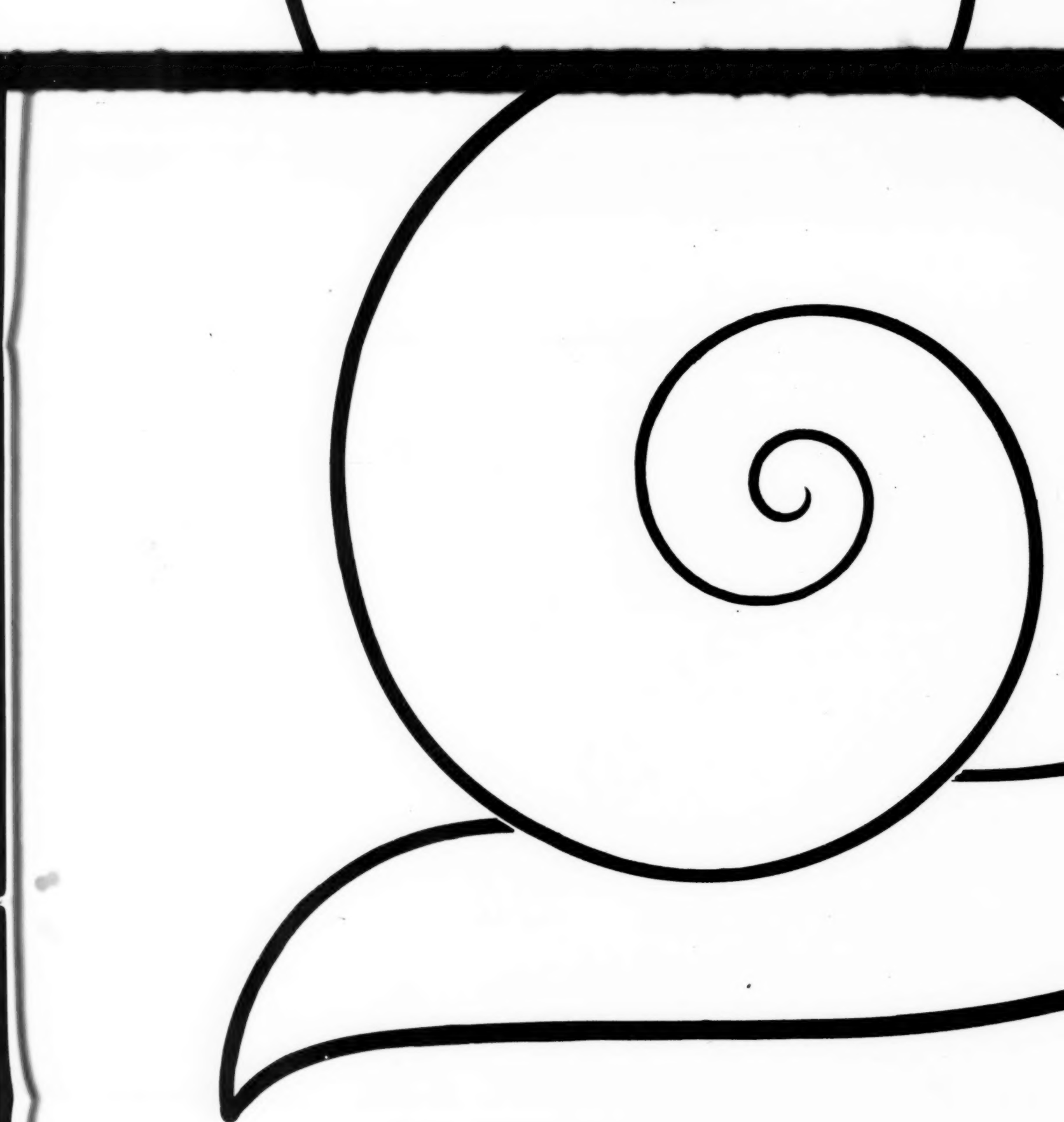

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